STAR

SEPTEMBER 23, 1966

VOLUME 4 • NUMBER 18

N66-31386—N66-32685

DOCUMENTS DEPT.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

OCT 21 1966

Duke University Library

Purchase of *STAR*

The semimonthly issues and the cumulative index issues are available postpaid on subscription and in single copy from the Superintendent of Documents, United States Government Printing Office, Washington, D.C., 20402, United States of America.

Semimonthly issues. Annual subscription rate: $33.00, domestic; $42.00, foreign. Price per single copy: $2.25, domestic; 25¢ extra for foreign mailing.

Cumulative index issues. Annual subscription rate: $30.00, domestic; $35.00, foreign. Price per single copy varies according to the number of pages.

Domestic subscription rates apply to the United States, Canada, Mexico, and all Central and South American countries, except as noted below.

Foreign subscription rates apply to Argentina, Brazil, British and French Guiana, Surinam, British Honduras, and all other countries throughout the world.

Payment should be by check, money order, or document coupons, and must accompany order. Remittances from foreign countries should be made by international money order, or draft on an American bank, payable to the Superintendent of Documents, or by UNESCO book coupons.

Published by:
United States Government
National Aeronautics and Space Administration
Scientific and Technical Information Division

Scientific and Technical Aerospace Reports, Volume 4, is prepared by the NASA Scientific and Technical Information Facility operated for the National Aeronautics and Space Administration by Documentation Incorporated.

Use of funds for printing this publication approved by the Director of the Bureau of the Budget June 7, 1966

Introduction

Scientific and Technical Aerospace Reports (STAR) is a comprehensive abstracting and indexing journal covering worldwide report literature on the science and technology of space and aeronautics. It is published twice each month.

Major areas covered in *STAR* are:

- Scientific and technical reports of the National Aeronautics and Space Administration and its contractors.
- Scientific and technical reports of government agencies, universities, and research organizations throughout the world.

The first section of *STAR*, arranged in 34 categories, contains abstracts and bibliographic citations (see p. vi). A second section consists of five indexes: subject, corporate source, author, report/accession number, and accession/report number. Separate cumulative indexes are published quarterly, except for the fourth quarter, which is an annual index. Cumulative indexes also contain a contract number index.

Readers are encouraged to examine the abstracts in each category of interest. If time is short, and when interest is concentrated in specific areas, readers may wish instead to scan source, author, and subject indexes. A more thorough coverage of a subject field may often be achieved by detailed examination of the subject listings, especially as they are cross-indexed in the quarterly indexes.

NASA documents (identified with an asterisk), as well as *STAR* itself, are available without charge to:

1. NASA Offices, Centers, contractors, subcontractors, grantees, and consultants.
2. Other U.S. Government agencies and their contractors.
3. Libraries in the United States that maintain collections of NASA documents for public reference.
4. Other organizations in the United States having a need for NASA documents in work related to the aerospace program.
5. Foreign government or academic (university) organizations that have established reciprocal arrangements for the exchange of publications with NASA, that have current agreements for scientific and technical cooperative activities with NASA, or that have agreements with NASA to maintain depositories of NASA documents for public use.

NASA documents that have been placed on microfiche are identified with the symbol #. They are available in microfiche form without charge to the organizations listed above.

Foreign non-copyrighted documents will be provided to U.S. Government Agencies and their contractors. AGARD reports that are not commercially available will also be provided by NASA to the domestic organizations listed above.

Other non-NASA documents are provided by NASA without charge only to NASA Offices, Centers, contractors, subcontractors, grantees, and consultants.

How to Request Listed Documents

If you are registered with NASA, send a completed *Document Request* (Facility Form 492) to:

NASA Scientific and Technical Information Facility
P.O. Box 33
College Park, Maryland 20740

If you are eligible to receive documents without charge (see previous page) but are not registered with NASA, request *Registration Form—Technical Publications* (Facility Form 713) from:

Scientific and Technical Information Facility
Attention: NASA Representative
P.O. Box 33
College Park, Maryland 20740

How the Public May Obtain Listed Documents

For reference purposes, NASA documents listed in *STAR* may be consulted at one of the organizations listed on the inside back cover. Commercial publications listed in *STAR* may usually be consulted in libraries or purchased from publishers or booksellers.

The public may purchase NASA documents and non-copyrighted foreign documents listed in *STAR* from either of two sales agencies, specifically identified in the abstract section:

- Clearinghouse for Federal Scientific and Technical Information (CFSTI), Springfield, Virginia 22151
- Superintendent of Documents (GPO), U.S. Government Printing Office, Washington, D.C. 20402

Documents available from the Clearinghouse for Federal Scientific and Technical Information are sold in hard-copy and microfiche form. If printed hard-copy is not available, a facsimile copy is provided. The symbols "HC" and "MF" are used in the abstract section to designate the copy available: "HC" (hard-copy) for full-size or facsimile; "MF" for microfiche. The price is also given. Following the availability information in the citation of each NASA-supported document is a code, e.g., CSCL 25A, indicating the subject category assigned to that document from the *COSATI Subject Category List* (first ed., December, 1964) published by the Committee on Scientific and Technical Information of the Federal Council for Science and Technology.

The public may request non-NASA documents by writing to the source, or other information systems. Identification other than the NASA accession number (N66-12345) should always be provided when requesting such a document from its source.

Abstracts of Journal Articles

By arrangement between NASA and the American Institute of Aeronautics and Astronautics, the AIAA publication *International Aerospace Abstracts* is issued in coordination with *STAR*. Each journal appears on alternate weeks. *IAA* uses identical subject categories with those in *STAR*, and publishes similar indexes. *IAA's* worldwide coverage of books and scientific and trade journals complements *STAR's* worldwide report coverage. The two publications thus provide comprehensive access to current literature on aerospace science and technology.

Organizations having a NASA contract may obtain *IAA* by writing NASA, Code USS-A, Washington, D.C., 20546. Others should direct inquiries to the American Institute of Aeronautics and Astronautics, 750 Third Avenue, New York, N.Y. 10017.

Table of Contents

Volume 4 Number 18 / September 23, 1966

Abstracts in the journal are grouped under the following categories: PAGE

01 AERODYNAMICS

Includes aerodynamics of bodies, combinations, internal flow in ducts and turbomachinery; wings, rotors, and control surfaces. For applications see: 02 Aircraft and 31 Space Vehicles. For related information see also: 12 Fluid Mechanics; and 33 Thermodynamics and Combustion. 3465

02 AIRCRAFT

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics. 3470

03 AUXILIARY SYSTEMS

Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines; hydraulic, pneumatic and electrical systems; actuators; and inverters. For related information see also: 09 Electronic Equipment; 22 Nuclear Engineering; and 28 Propulsion Systems. 3473

04 BIOSCIENCES

Includes aerospace medicine, exobiology, radiation effects on biological systems; physiological and psychological factors. For related information see also: 05 Biotechnology. 3477

05 BIOTECHNOLOGY

Includes life support systems, human engineering; protective clothing and equipment; crew training and evaluation, and piloting. For related information see also: 04 Biosciences. 3494

06 CHEMISTRY

Includes chemical analysis and identification (e.g., spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 27 Propellants. 3498

07 COMMUNICATIONS

Includes communications equipment and techniques; noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation. 3506

08 COMPUTERS

Includes computer operation and programming; and data processing. For basic research see: 19 Mathematics. 3512

09 ELECTRONIC EQUIPMENT

Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors; integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation. 3515

10 ELECTRONICS
Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see: Specific Physics Categories. **3520**

11 FACILITIES, RESEARCH AND SUPPORT
Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations. . . . **3523**

12 FLUID MECHANICS
Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion. **2526**

13 GEOPHYSICS
Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences. **3533**

14 INSTRUMENTATION AND PHOTOGRAPHY
Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gages; recorders; transducers; aerial photography; and telescopes and cameras. **3545**

15 MACHINE ELEMENTS AND PROCESSES
Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control, reliability; drafting; and materials fabrication, handling, and inspection. **3557**

16 MASERS
Includes applications of masers and lasers. For basic research see: 26 Physics, Solid-State. **3564**

17 MATERIALS, METALLIC
Includes cermets; corrosion; physical and mechanical properties of materials; metallurgy; and applications as structural materials. For basic research see: 06 Chemistry. For related information see also: 18 Materials, Nonmetallic; and 32 Structural Mechanics. **3566**

18 MATERIALS, NONMETALLIC
Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For basic research see: 06 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellants; and 32 Structural Mechanics. **3572**

19 MATHEMATICS
Includes calculation methods and theory; and numerical analysis. For applications see: 08 Computers. **3574**

20 METEOROLOGY
Includes climatology; weather forecasting; and visibility studies. For related information see also: 13 Geophysics; and 30 Space Sciences. **3577**

21 NAVIGATION
Includes guidance; autopilots; star and planet tracking; inertial platforms; and air traffic control. For related information see also: 07 Communications. **3580**

22 NUCLEAR ENGINEERING
Includes nuclear reactors and nuclear heat sources used for propulsion and auxiliary power. For basic research see: 24 Physics, Atomic, Molecular, and Nuclear. For related information see also: 03 Auxiliary Systems; and 28 Propulsion Systems. **3581**

23 PHYSICS, GENERAL
Includes acoustics, cryogenics, mechanics, and optics. For astrophysics see: 30 Space Sciences. For geophysics and related information see also: 13 Geophysics, 20 Meteorology, and 29 Space Radiation. 3591

24 PHYSICS, ATOMIC, MOLECULAR, AND NUCLEAR
Includes atomic, molecular and nuclear physics. For applications see: 22 Nuclear Engineering. For related information see also: 29 Space Radiation. 3595

25 PHYSICS, PLASMA
Includes magnetohydrodynamics. For applications see: 28 Propulsion Systems. 3608

26 PHYSICS, SOLID-STATE
Includes semiconductor theory; and superconductivity. For applications see: 16 Masers. For related information see also: 10 Electronics. 3611

27 PROPELLANTS
Includes fuels; igniters; and oxidizers. For basic research see: 06 Chemistry; and 33 Thermodynamics and Combustion. For related information see also: 28 Propulsion Systems. 3616

28 PROPULSION SYSTEMS
Includes air breathing, electric, liquid, solid, and magnetohydrodynamic propulsion. For nuclear propulsion see: 22 Nuclear Engineering. For basic research see: 23 Physics, General; and 33 Thermodynamics and Combustion. For applications see: 31 Space Vehicles. For related information see also: 27 Propellants. 3616

29 SPACE RADIATION
Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. For related information see also: 13 Geophysics; and 24 Physics, Atomic, Molecular, and Nuclear. 3619

30 SPACE SCIENCES
Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbit and trajectory. For related information see also: 11 Facilities, Research and Support; and 31 Space Vehicles. 3623

31 SPACE VEHICLES
Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see: 30 Space Sciences. For related information see also: 28 Propulsion Systems; and 32 Structural Mechanics. 3644

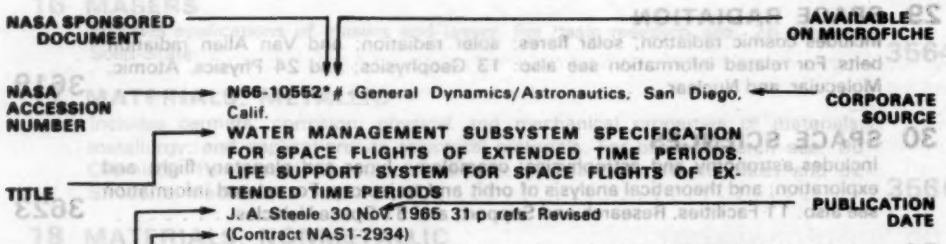
32 STRUCTURAL MECHANICS
Includes structural element design and weight analysis; fatigue; thermal stress; impact phenomena; vibration; flutter; inflatable structures; and structural tests. For related information see also: 17 Materials, Metallic; and 18 Materials, Nonmetallic. 3651

33 THERMODYNAMICS AND COMBUSTION
Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also: 12 Fluid Mechanics; and 27 Propellants. 3666

34 GENERAL
Includes reports of a broad nature related to industrial applications and technology, and to basic research; defense aspects; law and related legal matters; and legislative hearings and documents. 3674

SUBJECT INDEX I-1
CORPORATE SOURCE INDEX I-69
PERSONAL AUTHOR INDEX I-87
REPORT/ACCESSION NUMBER INDEX I-115
ACCESSION/REPORT NUMBER INDEX I-125

TYPICAL CITATION AND ABSTRACT FROM *STAR*


NASA SPONSORED DOCUMENT
AVAILABLE ON MICROFICHE
NASA ACCESSION NUMBER
N66-10552*# General Dynamics/Astronautics, San Diego, Calif.
CORPORATE SOURCE
TITLE
WATER MANAGEMENT SUBSYSTEM SPECIFICATION FOR SPACE FLIGHTS OF EXTENDED TIME PERIODS. LIFE SUPPORT SYSTEM FOR SPACE FLIGHTS OF EXTENDED TIME PERIODS
PUBLICATION DATE
J. A. Steele 30 Nov. 1965 31 p refs Revised
AUTHOR
(Contract NAS1-2934)
(NASA-CR-67600; GD/A-64-26211, Rev. A) CFSTI: HC $2.00/MF $0.50 CSCL 06K
SALES AGENCY AND PRICE
CONTRACT OR GRANT
The water management subsystem specifications are presented for the equipment required in an operational water management program as an integral part of the life support system for space flight. The requirements of the subsystem components are summarized and the operational procedures for normal and emergency situations are outlined. Both the prototype and the flight systems are discussed.
REPORT NUMBER
E.E.B.
COSATI CODE

VOLUME 4 NUMBER 18

Scientific and Technical Aerospace Reports

A Semimonthly Publication of the National Aeronautics and Space Administration

September 23, 1966

01 AERODYNAMICS

Includes aerodynamics of bodies, combinations, internal flow in ducts and turbo machinery; wings, rotors, and control surfaces. For applications see: 02 Aircraft and 31 Space Vehicles. For related information see also: 12 Fluid Mechanics; and 33 Thermodynamics and Combustion.

N66-31572# Purdue Research Foundation, Lafayette, Ind. Fluid Mechanics Group.

AN EXPERIMENTAL INVESTIGATION ON THE EFFECT OF SUBSONIC INLET MACH NUMBER ON THE PERFORMANCE OF CONICAL DIFFUSERS

Robert V. Van Dewoestine and Robert W. Fox Feb. 1966 79 p refs

(Contract DA-31-124-ARO(D)-138) (FMTR-66-1; AROD-4332-4; AD-632787) CFSTI: HC $3.00/MF $0.75

Experiments were performed to determine the effect of subsonic inlet Mach number on diffuser performance and flow regimes for a wide range of conical diffuser geometries. As the Mach number is increased, the flow tends more toward separation in all cases. Diffuser performance maps are presented for three different inlet Mach numbers (S_1=0.25, 0.55, 0.70). There is no significant variation in the location of the line of maximum performance at constant length to inlet radius ratio, line alpha–alpha, with Mach number. Author (TAB)

N66-31589# General Electric Co., Philadelphia, Pa.

PREDICTION OF THE BOUNDARY LAYER ACOUSTIC PRESSURE LEVELS OF A BLUNT NOSE RE-ENTRY VEHICLE AT HIGH MACH NUMBERS

H. Saunders and D. E. Nestler *In* Naval Res. Lab. The Shock and Vibration Bull., No. 35, Pt. 7 Apr. 1966 p 19-23 refs (See N66-31588 18-32) CFSTI: HC $6.00/MF $1.50

Equations are derived for predicting the acoustic levels during reentry of a blunt-nosed vehicle in terms of trajectory-dependent variables. The equations employ experimental data for the ratio of fluctuating pressure level to local dynamic pressure. Transformation from local to free stream conditions is accomplished by use of isentropic expansion relations from the stagnation pressure behind a normal shock to local body pressure determined by the modified Newtonian method. A chart is presented for determining the effective isentropic exponent γ considering real gas effects associated with the high static temperatures behind the bow shock wave. Author

N66-31611# College of Aeronautics, Cranfield (England).

SLENDER SHAPES OFFERING MINIMUM DRAG IN FREE-MOLECULAR FLOW

E. A. Boyd Sep. 1965 24 p refs Presented at the 7th Symp. on Advanced Probl. and Methods in Fluid Dyn., Jurata, Poland, 1–7 Sep. 1965 Submitted for Publication

(CoA-AERO-166) CFSTI: HC $1.00/MF $0.50

Analytical expressions are obtained for the optimum shapes which minimize the drag of a slender axisymmetric body in free-molecular flow, provided the drag expression is simplified using the slenderness assumption. The problem is formulated as one of Mayer type in the calculus of variations and solved by using the Euler–Lagrange equations together with the transversality condition. The shapes derived are optimum subject to constraints on thickness, length, wetted area and volume. In the particular cases solved any two of these four quantities are fixed while the remaining two are free. The expression for the shape of the body when thickness is free is obtained in closed form. Author

N66-31619# RAND Corp., Santa Monica, Calif.

INTERPRETATION OF RECOVERY-TEMPERATURE MEASUREMENTS AT LOW REYNOLDS NUMBERS

C. Forbes Dewey, Jr. Apr. 1966 17 p refs

(Contract ARPA-SD-79; ARPA Order 189-1) (RM-4673-ARPA)

This memorandum demonstrates that the wire recovery temperature in a steady state flow may be accurately determined without a detailed knowledge of the convective heat transfer rate to the wire. The analysis is valid even for large conduction losses at the wire supports, and a similar analysis could be made for transient conditions. Author

N66-31727*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

LOW-SPEED MEASUREMENTS OF OSCILLATORY LATERAL STABILITY DERIVATIVES OF A MODEL OF 60° DELTA-WING BOMBER

John W. Paulson Washington, NASA, Aug. 1959 36 p ref (NASA-TM-X-13) CFSTI: HC $2.00/MF $0.50 CSCL 01D (Declassified)

An investigation to determine rolling, yawing, and sideslipping derivatives has been made in the Langley free-flight tunnel. Tests were made of the composite (pod-on) and return-component (pod-off) configurations with vertical tail on and off. There was, in general, little effect of frequency on the values of the derivatives up to an angle of attack of about 20°.

There were only small differences in the rolling and yawing derivatives for the composite and return-component configurations. Author

N66-31729*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
THE TRANSONIC AERODYNAMIC CHARACTERISTICS OF TWO VARIABLE-SWEEP AIRPLANE CONFIGURATIONS CAPABLE OF LOW-LEVEL SUPERSONIC ATTACK
Ralph P. Bielet, A. Warner Robins, and William J. Alford, Jr. Washington, NASA, Aug. 1960 55 p refs (Declassified)
(NASA-TM-X-304) CFSTI: HC $2.50/MF $0.50 CSCL 01D

The aerodynamic characteristics of two variable-sweep airplane configurations capable of low-level supersonic attack have been investigated. The wind-tunnel results have indicated that the configurations with maximum wing sweep had high Mach numbers for the drag rise and low values of the zero-lift drag-rise characteristics. For the configuration with 25° wing sweep, high values of maximum lift-drag ratio were indicated. Author

N66-31730*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
TRANSONIC AND SUPERSONIC FLUTTER TREND INVESTIGATION OF A VARIABLE-SWEEP WING
John C. Stonesifer and Robert C. Goetz Washington, NASA, Oct. 1961 29 p refs (Declassified)
(NASA-TM-X-598) CFSTI: HC $2.00/MF $0.50 CSCL 01D

Models were tested at Mach numbers of about 0.5 to 2.55 in the Langley transonic blowdown and in the Langley 9- by 18-inch supersonic aeroelasticity tunnels. Three planforms were tested in order to represent the variable-sweep wing in three sweep positions. All of these planforms had inboard panels with the leading edge swept back 60°, whereas the outboard panels were swept back 25°, 60°, and 75° at the leading edge. The models were of simple construction and did not simulate joint flexibility. Author

N66-31731*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
STABILITY AND CONTROL CHARACTERISTICS AT A MACH NUMBER OF 1.97 OF AN AIRPLANE CONFIGURATION HAVING TWO TYPES OF VARIABLE-SWEEP WINGS
Gerald V. Foster and Odell A. Morris Washington, NASA, Aug. 1960 48 p refs (Declassified)
(NASA-TM-X-323) CFSTI: HC $2.00/MF $0.50 CSCL 01D

One wing incorporated an outboard pivot with the inboard section fixed at a sweep angle of 60° and the outboard wing section at sweep angles of both 75° and 113°. The other wing had the pivot within the body, and a sweep angle of 70.5°. Tests were also made to determine the effects of horizontal-tail dihedral and the effects of canard surfaces on the longitudinal and lateral stability. Author

N66-31859*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
LOW-SPEED TESTS OF 50°-SWEPT PARAWINGS APPLIED TO A 0.17-SCALE MODEL OF A MANNED FLIGHT VEHICLE
Frank M. Bugg Washington, NASA, Aug. 1966 54 p refs
(NASA-TN-D-3493) CFSTI: HC $3.00/MF $0.50 CSCL 01A

A low-speed wind-tunnel investigation was made to determine the performance and control characteristics of a 0.17-scale model of a manned flight vehicle with several different parawings of 50° sweep. The effects of aspect ratio, flat-pattern sweep, leading-edge taper, trailing-edge curvature, parawing material, chord extensions, and wing position relative to the fuselage were studied. Increasing the aspect ratio benefited the longitudinal control characteristics. The stick-force gradient with speed computed with the pivot point at the quarter-chord position of the mean aerodynamic chord on the parawing keel center line was negative (unstable) for all parawing configurations investigated and generally less negative for aspect-ratio-5.00 and -5.45 parawings than for aspect-ratio-2.57 parawings. Pivot-point locations which gave stable (positive) stick-force gradients with speed were computed for aspect-ratio-5.00 and -2.57 parawings with 45.0° flat-pattern sweep. The use of chord extensions and increased flat-pattern sweep increased the lift–drag ratio of the model. The maximum lift–drag ratio of the model in this investigation was 4.15 and was obtained by using a modified aspect-ratio-5.45 parawing with a flat-pattern sweep of 45.0°; the maximum lift–drag ratio of this wing alone was 6.6. Author

N66-31880# National Aerospace Lab., Tokyo (Japan).
DYNAMIC TESTING AT TRANSONIC SPEED
Yasujiro Kobashi, Nagamasa Kawano, and Takenori Nisi 1965 30 p refs In JAPANESE; ENGLISH summary
(NAL-TR-93) CFSTI: HC $2.00/MF $0.50

A method for measuring dynamic stability derivatives of airplane and rocket models in a transonic wind tunnel is described. The characteristic features of this system are the degree of freedom inexorable forced oscillations employing hydraulic servo mechanism, and the device for minimizing the inertia effect by using a light model and a specially designed moment type balance system. Data reduction of each derivative from measured aerodynamic loads are also investigated. With the equipment, aerodynamic derivatives such as pitching moment slope $C_{m\alpha}$, total pitch damping derivative $(C_{m\dot{\alpha}}+C_{mq})$, downwash lag derivative $C_{m\dot{\alpha}}$, direct pitch damping derivative C_{mq}, and roll-damping derivative C_{lp} have been obtained for several models. From the longitudinal test for a two staged rocket model, it is clarified that the derivatives are considerably affected by the reduced frequency and Mach number, and at high reduced frequency the total pitch damping derivative shows unstable tendency. Reasonable values of roll damping derivatives are obtained from the lateral test for several models. Author

N66-31884# National Aerospace Lab., Tokyo (Japan).
SOME EFFECTS OF TAPER RATIO ON THE TRANSONIC FLUTTER CHARACTERISTICS OF A SERIES OF THIN CANTILEVER WINGS HAVING A SWEPTBACK ANGLE OF 45° AND AN ASPECT RATIO 4.0
Eiichi Nakai, Toshiro Takagi, and Yasukatsu Ando 1966 20 p refs In JAPANESE; ENGLISH summary
(NAL-TR-98) CFSTI: HC $1.00/MF $0.50

An experimental investigation of some effects of taper ratio on the flutter characteristics of a series of thin cantilever wings having a sweptback angle of 45° and an aspect ratio of 4.0 has been conducted in the transonic blowdown wind tunnel for flutter testing at Mach numbers between 0.872 to 1.206. The results are presented as ratios between the experimental flutter speeds and the reference flutter speeds calculated on the basis of incompressible two-dimensional flow. These ratios, designated the flutter speed ratios, are given as functions of Mach numbers for the wings tested. The flutter speed ratios were characterized by the minimum values

at around Mach number 1.0 with the increase in the speed ratios in the range of subsonic and supersonic speeds investigated. Author

N66-31910# National Aerospace Lab., Tokyo (Japan).
LINEARIZED AERODYNAMIC THEORY OF ROTOR BLADES. III: METHOD FOR SOLVING LIFTING-LINE EQUATIONS
Taruo Ichikawa 1966 42 p refs In JAPANESE; ENGLISH summary
(NAL-TR-100) CFSTI: HC $2.00/MF $0.50

A method for solving lifting-line integral equations of the rotor blade which have been derived in the previous report is presented. Singularities of the kernels are investigated and the kernels are divided into singular and non-singular parts. By applying a collocation technique, the integral equations are reduced to sets of linear simultaneous algebraic equations. Some numerical computations are carried out for hovering and forward flight cases and are compared with experimental values published by NACA. Author

N66-31943*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PRESSURE MEASUREMENTS ON RIGID MODEL OF BALLUTE DECELERATOR AT MACH NUMBERS FROM 0.56 TO 1.96
Raymond A. Turk Washington, NASA, Aug. 1966 16 p refs
(NASA-TN-D-3545) CFSTI: HC $1.00/MF $0.50 CSCL 01A

A pressure test of a 9-inch-diameter solid model of a ram-air-inflated conical balloon decelerator (ballute) was conducted in the Lewis 8- by 6-foot transonic wind tunnel over a Mach number range from 0.56 to 1.96 and a corresponding Reynolds number range from 3.60×10^6 to 4.90×10^6 per foot. Data were obtained with and without a cone-cylinder-flare forebody positioned between 0 and 16 forebody diameters forward of the decelerator. Drag coefficients were calculated from the pressure distributions. In the subsonic regime the pressures and corresponding drag coefficients decrease slightly with increased separation distance. At supersonic speeds a discontinuous variation in pressure profile and, hence, drag coefficient was obtained with increased separation distance. At close distances the ballute caused divergence of the forebody wake, and the resulting pressures and drags were low. As the ballute was moved aft, the forebody wake converged and the measured pressure and corresponding drag were higher. At Mach numbers of 1.36 and greater, an intermediate range of separation distance was detected in which the type of forebody wake and, hence, pressure level and drag coefficient depended on the direction of ballute travel. For the cone-cylinder-flare forebody employed, a deployment to a distance of at least 4.2 forebody diameters was required to obtain maximum drag for Mach numbers of 1.36 and greater. Author

N66-31949# Institute of Technology, Helsinki (Finland).
ON THE INTEGRAL TRANSFORMATION OF THE LINEARIZED PERTURBATION VELOCITY POTENTIAL
Matti A. Ranta 1965 26 p refs
(ME-22) CFSTI: HC $2.00/MF $0.50

It is stated that integral transformations provide a convenient method of solving linear differential equations; however, there are a large number of transformations which correspond to different kernels. The selection of the kernel depends primarily upon the nature of a problem, and expressly upon the boundary condition. Reported are the results of an effort to achieve the correct application of an arbitrary triple transformation to the differential equation of perturbation velocity potential. The transformation is carried out in x-, y-, and t-coordinates. Also included is an analysis of the characteristics surfaces and of the discontinuity in the field. The basic formulas are derived and the steps in the transformation are delineated. H.S.W.

N66-31953# National Aerospace Lab., Tokyo (Japan).
ON THE CAMBER LINES OF SEMI-INFINITE SWEPTBACK WINGS WHICH GIVE UNIFORM SPANWISE LOAD DISTRIBUTION
Toshio Kawasaki 1965 26 p refs In JAPANESE; ENGLISH summary
(NAL-TR-94) CFSTI: HC $2.00/MF $0.50

It is well known that sweptback wings are very effective to raise critical Mach numbers in transonic flow. In experiments, however, the increase in critical Mach number is less than what is expected from the simple sweptback theory. The reason lies in the fact that at the center and the tip of the airfoil isobars tend to be normal to the direction of the undisturbed flow, in contrast with the flow pattern given by the simple sweptback theory. In this report, we looked for the camber which produces uniform spanwise lift distributions even at and near the center section. For the case of subsonic flow, we gave numerical examples for the general roof-top lift distributions. The calculated results show quite a large variation of camber near the center section, and we anticipate some trouble in practical application of airfoils based on such design philosophy. Author

N66-31958# College of Aeronautics, Cranfield (England).
ON THE FLOW ALONG SWEPT LEADING EDGES
M. Gaster Oct. 1965 26 p refs
(CoA-AERO-167) CFSTI: HC $2.00/MF $0.50

Flight tests on a suction wing showed that turbulence, generated at the wing root, can propagate along the leading edge and cause the whole flow to be turbulent. The flow on the attachment line of a swept wing was studied in a low speed wind tunnel with particular reference to the problem of turbulent contamination. The critical Reynolds number, $R\theta_L$ of the attachment line boundary layer for the spanwise spread of turbulence was found to be about 100 for sweep angles in the range 40°–60°. A device was developed to act as a barrier to the turbulent root flow so that a clean laminar flow could exist outboard. This device was shown to be effective up to an $R\theta$ of at least 170. With the aid of this bump experiments were possible on a laminar boundary layer at Reynolds numbers above the lower critical value. The behavior of Tollmien–Schlichting waves was also investigated by exciting the flow with sound emanating from a small hole on the attachment line. Measurements of the perturbation phase and amplitude were made downstream of the source. Author

N66-32165# RAND Corp., Santa Monica, Calif.
AERODYNAMICS OF BODIES OF REVOLUTION
Nikolai F. Krasnov Aug. 1965 104 p Transl. into ENGLISH from the book "Aerodinamika Tel Vrashcheniia" (USSR), 1964
(LT-65-15; AD-629643) CFSTI: HC $4.00/MF $0.75

The method of characteristics is considered in this chapter of a Soviet book dealing with the aerodynamics of bodies of revolution. Attention is given to the calculation of symmetric potential and rotational flows, as well as to the method of characteristics as applied to the calculation of symmetric flows at very high temperatures. The last includes a calculation scheme

for dissociating rotational flow near a body of revolution. The method is then applied to flow calculation at angle of attack; and experimental data and approximate methods are included.
M.W.R.

N66-32214# David Taylor Model Basin, Washington, D. C. Aerodynamics Lab.
INCREMENTAL LIFT AND DRAG OF AN EXTERNAL AIRCRAFT STORE—PHASE II (50° SWEEP)
Charles S. Swinney Mar. 1966 94 p refs
(AL-27; AD-481906)

A wind-tunnel study was conducted to determine the effect of store location, arrangement, and incidence, as well as the effect of aircraft wing leading-edge geometry on the lift and drag characteristics of a generalized wing-body aircraft. Wind tunnel tests were performed at Mach numbers between 0.80 and 1.15 at aircraft angles of attack between −3 and 15 deg. The generalized wing-body aircraft had a wing leading-edge sweep angle of 50°. A similar study was conducted using the same generalized wing-body with a wing leading edge sweep angle of 25 deg.
Author (TAB)

N66-32244*# British Columbia Univ., Vancouver.
AMPLITUDE AND SURFACE PRESSURE MEASUREMENTS FOR A CIRCULAR CYLINDER IN VORTEX-EXCITED OSCILLATION AT SUBCRITICAL REYNOLDS NUMBERS
G. V. Parkinson and N. Ferguson (Nova Scotia Tech. Coll.) *In* NASA. Langley Res. Center Meeting on Ground Wind Load Probl. in Relation to Launch Vehicles [1966] 12 p refs (See N66-32226 18-32) CFSTI: HC $5.29/MF $2.25

Measurements are presented of cylinder amplitude and frequency, wake vortex formation frequency, and phase angle between lateral force and displacement, as a function of wind speed, for a circular cylinder tested at subcritical Reynolds numbers in a wind tunnel. Oscilloscope photographs of cylinder displacement and surface pressure are shown, illustrating changes in relative amplitudes, and in amplitude modulation, with wind speed in the vortex-excited range.
Author

N66-32245*# Naval Postgraduate School, Monterey, Calif.
FLUCTUATING FORCE MEASUREMENTS UPON A CIRCULAR CYLINDER AT REYNOLDS NUMBERS UP TO 5×10^6
Louis V. Schmidt *In* NASA. Langley Research Center Meeting on Ground Wind Load Probl. in Relation to Launch Vehicles [1966] 17 p refs Supported in part by NSF (See N66-32226 18-32) CFSTI: HC $5.29/MF $2.25

An approximate 8:1 aspect ratio circular cylinder has been extensively tested both in the 10-foot low speed circular wind tunnel and in the 12-foot pressure tunnel. The results of these tests provide a coverage in Reynolds number from approximately 3×10^5 to 5×10^6. Data obtained included the steady and fluctuating values of sectional lift and drag in addition to individual surface static pressures. Multiple data stations allowed the determination of the spatial traits of the random-type air loads. The model, essentially rigid, had interchangeable tip sections. A clear demonstration of the effects of tip shape upon sectional air loads was obtained in addition to a definition of the scope of this influence. Studies of bluff body separation effects have been made upon square, rectangular, and circular cross sections using a simple single degree of freedom aeroelastic model. Significant differences have been observed in the aerodynamic forcing function for various bluff bodies. This program has application to an antenna element vibration problem.
Author

N66-32246*# Martin Co., Baltimore, Md.
EXPERIMENTAL INVESTIGATION OF WIND INDUCED OSCILLATION EFFECTS ON CYLINDERS IN TWO-DIMENSIONAL FLOW AT HIGH REYNOLDS NUMBERS
Joseph J. Cincotta, George W. Jones, Jr., (NASA. Langley Res. Center), and Robert W. Walker (NASA. Marshall Space Flight Center) *In* NASA. Langley Res. Center Meeting on Ground Wind Load Probl. in Relation to Launch Vehicles [1966] 35 p refs (See N66-32226 18-32) CFSTI: HC $5.29/MF $2.25

The tests were performed on a stationary and oscillating model for a model Strouhal number range from 0.06 to 0.5. With increasing Reynolds number the unsteady lift force characteristic changed from wide band random to narrow band random to random plus periodic. The Strouhal number of the unsteady aerodynamic force on the stationary model increased with increasing Reynolds number to a constant value of 0.3 in the random plus periodic Reynolds number range. In the transcritical regime, the unsteady lift forces were found to increase with amplitude of model oscillation, with the maximum amplification occurring when the model oscillating frequency was approximately equal to the aerodynamic Strouhal frequency. For model oscillation frequencies below the stationary model aerodynamic Strouhal frequency, the unsteady lift forces exhibited negative aerodynamic damping characteristics. Mach number was found to effect both the static drag and unsteady lift data for Mach number greater than 0.2. For Reynolds numbers above 3 million and Mach number ≤ 0.2 the static drag coefficient was relatively constant at approximately 0.54.
Author

N66-32248*# Pennsylvania State Univ., University Park. Dept. of Aeronautical Engineering.
EFFECTS OF TURBULENCE ON VORTEX SHEDDING FROM CIRCULAR CYLINDERS
Maurice Sevik *In* NASA. Langley Res. Center Meeting on Ground Wind Load Probl. in Relation to Launch Vehicles [1966] 19 p refs (See N66-32226 18-32) CFSTI: HC $5.29/MF $2.25

The wind and water tunnels and the experimental techniques which will be employed to determine the free stream turbulent effects on characteristics of time-dependent forces acting on circular cylinders are described. The desired transfer function depends on Reynolds number, turbulent velocity fluctuation intensity, length–dimension ratio, spectral distribution of turbulent energy, and the ratio of cylinder surface to the boundary layer thickness. The anticipated behavior is discussed.
N.E.N.

N66-32249*# Nebraska Univ., Lincoln.
IMPULSE AND ACCELERATED FLOW ABOUT CYLINDERS
Turgut Sarpkaya *In* NASA. Langley Res. Center Meeting on Ground Wind Load Probl. in Relation to Launch Vehicles [1966] 73 p refs (See N66-32226 18-32) CFSTI: HC $5.29/MF $2.25

This paper presents a study of the characteristics of impulsively started steady flow and uniformly accelerated unsteady flow about circular cylinders and discusses the merits of various mathematical models and theoretical methods. In addition, the fluctuations of the lift and drag forces and the analogy between the impulsive flow over circular cylinders and the separated flow about lifting bodies are discussed and the cross-flow drag and normal force coefficients are presented.
Author

N66-32327*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.

NEWTONIAN AERODYNAMIC CHARACTERISTICS OF BLUNTED RIGHT ELLIPTICAL CONES FOR CONE THICKNESS RATIOS OF 0.25 TO 3

Ralph E. Graham, Robert H. Lamb, and Paul O. Romere Washington, NASA, Aug. 1966 74 p refs

(NASA-TN-D-3462) CFSTI: HC $3.00/MF $0.75 CSCL 01A

Equations have been derived and utilized to calculate the Newtonian aerodynamics of elliptical cones for cone cross-sectional thickness ratios ranging from 0.25 to 3.0 and for the complete range of bluntness. For each cross-sectional thickness ratio, the cones were blunted using prolate spheroids which were forced to be tangent to the cones. The static longitudinal aerodynamics for angles-of-attack from 0° to 180° and directional stability derivatives at zero angle-of-attack are presented in tabular form. It was found that for bluntness ratios less than or equal to 25 percent of maximum bluntness, the effects on the aerodynamics are small, but as the bluntness ratio increased above this value, the effects become more pronounced. For all configurations, increasing bluntness decreases the magnitude of normal-force and pitching-moment coefficients. Also, it was found that for all configurations an angle-of-attack exists at which axial force is independent of bluntness. Before this intersection point, axial force increases with increasing bluntness; however, after the intersection, axial force decreases with increasing bluntness. Author

N66-32526# Aircraft Research Association Ltd., Bedford (England).

STUDY OF CRITICAL AND LIMIT ROUGHNESS

Xavier Vaucheret and Jean-Marie Olive Feb. 1966 16 p refs Transl. into ENGLISH from Rech. Aerospatiale (France), no. 107, Jul.–Aug. 1965

(ARA-LIB-TRANS-13) CFSTI: HC $1.00/MF $0.50

The techniques of visualization and of transition fixing used in the Modane wind tunnels are described, as well as the visualization methods for determining the skin friction drag and the criteria used to define the critical and limit roughness. The transition visualization method involves the sublimation of a volatile product which, disappearing in the turbulent zones, makes the change in nature of the boundary layer apparent. Transition fixing is obtained by the affixing of graded particles for artificial roughness. The mean coefficient of friction of a flat plate is given; and the coefficients of drag are measured during sublimation in order to take account of contingent initiation of transition due to dust, especially during natural transitions. Values for critical and limit roughness Reynolds numbers are presented; and the transition Reynolds number of a wind tunnel is described as the guide between the two test techniques of natural or fixed transition. S.P.

N66-32577# Library of Congress, Washington, D. C. Aerospace Technology Div.

CALCULATION OF THE DISCHARGE CHARACTERISTICS OF NOZZLE CASCADES [K RASCHETU RASKHODNYKH KHARAKTERISTIK SOPLOVYKH APPARATOV] Surveys of Foreign Scientific and Technical Literature

16 Mar. 1966 20 p refs Transl. into ENGLISH from Teploenerg. (Moscow), no. 11, 1965 p 29–34

(ATD-66-23)

Methods are proposed for calculating the effect of various geometric and regime parameters of cascades and also of the steam moisture content on the discharge characteristics of turbine stages. The author makes the following conclusions: (1) The discharge coefficients, determined theoretically from the change in the relative thickness of the exit edges of nozzles and also from the geometrical flow exit angle, pressure ratio at the nozzle, and the relative blade heights, are in good agreement with experimental data and, therefore, the method described in this article may be recommended for practical application. (2) In nozzles of a single-stage turbine, subcooling of the steam flow occurs independently of the initial liquid content in steam. (3) The change in the relative thickness and height of the exit edges of nozzles quantitatively affect differectly the change in the discharge coefficients for superheated and the wet steam. The original article included 2 references. Author

N66-32624*# Boeing Co., Renton, Wash. Airplane Div.

LARGE TRANSPORT LANDING CHARACTERISTICS AS SIMULATED IN FLIGHT AND ON THE GROUND

J. W. Kerrigan and R. G. Root [1966] 241 p refs

(Contract NAS2-3224)

(NASA-CR-62036; D6-15000) CFSTI: HC $3.75/MF $1.50 CSCL 01A

The stability and control characteristics during low speed landing approaches of various large transport configurations were evaluated using the Boeing 367-80 airplane and the Ames moving base analog simulator. This report documents comparisons of the 367-80 and the moving base simulators to the theoretically calculated characteristic responses of the large transport configurations. For all maneuvers performed the simulation accuracy was satisfactory. Author

N66-32681*# Lockheed Missiles and Space Co., Sunnyvale, Calif.

DYNAMICS OF SEPARATED FLOW OVER BLUNT BODIES Technical Summary Report

Lars Eric Ericsson and J. Peter Reding Dec. 1965 87 p refs

/ts Rept.-2-80-65-1

(Contract NAS8-5338)

(NASA-CR-76912) CFSTI: HC $2.50/MF 0.75 CSCL 01A

Certain geometric features common to many manned boosters, such as tower-mounted escape rockets and steep interstage flares, are sources of flow separation that may dominate the vehicle dynamics in the transonic Mach number range where the dynamic pressure is large. Such is the case with the Saturn–Apollo manned boosters. Several specific types of flow separation occurring on the Saturn–Apollo launch vehicles have been singled out for special study. The dynamic effects of separated flow were derived using experimental static loads and quasi-steady methods. The quasi-steady predictions are shown to agree well with experimental dynamic results. Thus is the transonic dynamic instability of blunt-nosed, cylinder-flare reentry bodies closely predicted, and the undamping effect of a flow separation disk is readily forecasted. Furthermore, the aerodynamic damping measured on elastic models of the Saturn I-Apollo launch vehicle agreed well with the quasi-steady predictions, making it possible to predict with satisfactory accuracy the full-scale aeroelastic characteristics of the Saturn I booster, including several last minute changes in vehicle geometry, structure, and trajectory. Author

02 AIRCRAFT

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics.

N66-31728*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

COMPARISON OF CONTROL-FIXED STABILITY DERIVATIVES FOR TWO SUPERSONIC FIGHTER AIRPLANES AS DETERMINED FROM FLIGHT AND WIND-TUNNEL TESTS

Harold L. Crane, Milton D. Mc Laughlin, and Jack A. White Washington, NASA, Apr. 1959 37 p refs

(NASA-MEMO-2-3-59L) CFSTI: HC $2.00/MF $0.50 CSCL 01C (Declassified)

The tests were made at an altitude of 35,000 feet at Mach numbers up to 1.44 for one airplane and 1.23 for the other airplane. The static derivatives determined from the flight-test results were compared with those from wind-tunnel results which had been adjusted for the effects of differences in geometric configuration, aeroelastic distortion, and mass flow. Author

N66-31742*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

ANALYTICAL STUDIES OF THE RESPONSE TO LONGITUDINAL CONTROL OF THREE AIRPLANE CONFIGURATIONS IN LANDING APPROACHES

William Bihrle, Jr. and Ralph W. Stone, Jr. Washington, NACA, 9 Apr. 1953 50 p

(NACA-RM-L53B10) CFSTI: HC $2.00/MF $0.50 CSCL 01B (Declassified)

The results of a theoretical investigation, using an analog computer conducted to determine some effects of airplane configuration on the response to longitudinal control in landing approaches are presented. The response of three airplane configurations was compared and the effects of changing the available elevator deflection, the change in lift due to elevator deflection, the airplane damping, and the ratio of lift to drag on the response were determined. Author

N66-31853*# Boeing Co., Renton, Wash. Airplane Div.

367-80 AIRPLANE VARIABLE STABILITY SIMULATION SYSTEM (NASA LANGLEY SUPERSONIC TRANSPORT SIMULATION PROGRAM)

R. E. Robbins and S. D. Person [1965] 228 p refs

(Contract NAS1-4096)

(NASA-CR-66126; D6-19856) CFSTI: HC $3.75/MF $1.25 CSCL 01B

Use of a large four-engine jet airplane as an in-flight dynamic simulator is discussed for the simulation of other large transport type airplanes operating in the subsonic region, including the approach and landing phases of flight. Author

N66-31854*# Boeing Co., Renton, Wash. Airplane Div.

SIMULATION OF THREE SUPERSONIC TRANSPORT CONFIGURATIONS WITH THE BOEING 367-80 IN-FLIGHT DYNAMIC SIMULATION AIRPLANE

William M. Eldridge, P. M. Condit, Robert C. Schwanz, and C. R. Taylor [1966] 234 p refs

(Contract NAS1-4096)

(NASA-CR-66125; D6-10743) CFSTI: HC $3.75/MF $1.25 CSCL 01B

Use of an in-flight dynamic simulator is described for evaluating problems connected with low-speed approach and landing of supersonic transport (SST). Three variable geometry and delta SST configurations are evaluated, as well as a variable geometry airplane in an emergency wings back configuration (72° sweep). Systems of longitudinal and lateral-directional stability augmentation are developed and investigated; and the effect of center of gravity position is examined with and without longitudinal stability augmentation. Operation of the simulation airplane is described. In addition to the simulation documentation data presented, a number of maneuvers performed to document each configuration are listed. The overall simulation was successful; however, problems were encountered in setting up test configuratons with low longitudinal static stability, and simulating the delta and 72° sweep configurations was difficult due to the high cross-product-of-inertia. S.P.

N66-31914# Technisch Documentatie en Informatie Centrum voor de Krijgsmacht, The Hague (Netherlands).

SONIC BOOM: A LITERATURE SURVEY [SUPERSONE KNALLEN]

May 1966 82 p refs In ENGLISH, FRENCH, GERMAN, and DUTCH

(TDCK-45316) CFSTI: HC $2.50/MF $0.75

A bibliography of literature pertaining to effects of supersonic booms caused by shock waves from supersonic aircraft is presented. The annotated bibliographies cover general descriptions of the sonic boom phenomenon; shock wave theory; shock wave patterns around aircraft; the influence of atmospheric effects (temperature, pressure, and wind on the location and intensity of a sonic boom); ground measurements and effects on buildings, constructions, and other aircraft; operational aspects (factors in navigation and control of supersonic aircraft); and human subjective reactions to the sonic boom. L.S.

N66-31915# National Aerospace Lab., Tokyo (Japan).

A FEW COMMENTS ON THE LONGITUDINAL HANDLING QUALITIES OF AIRPLANES

Hiroshi Araki 1965 17 p refs In JAPANESE; ENGLISH summary

(NAL-TR-95) CFSTI: HC $1.00/MF $0.50

Flying qualities criteria as regards the longitudinal short-period oscillations of airplanes are generally represented by some restricted domains in the plane defined by the longitudinal short-period natural frequency and damping ratio as ordinate and abscissa. In the flight experiments on which the criteria are based, it seems that pilots must have evaluated the longitudinal handling characteristics as well as the dynamic stability of airplanes. In other words the airplanes pertaining to the satisfactory domain in the above mentioned plane are satisfactory rather as to longitudinal handling qualities than as to dynamic stability. From such a point of view the author suggests a more direct and simpler representation of the criterion on longitudinal handling qualities of airplanes, such as $a \leq T_R \leq b$, $1/\tau \geq c$, where T_R is response time to step input, $1/\tau$ is total damping, and a, b, c are some constants. Author

N66-31948# College of Aeronautics, Cranfield (England).
MEASUREMENT OF THE LATERAL STABILITY DERIVATIVES OF A MORANE-SAULNIER M.S. 760 'PARIS' AIRCRAFT G-APRU
W. G. Bradley Oct. 1965 48 p refs
(CoA-AERO-185) CFSTI: HC $2.00/MF $0.50

Flight tests were carried out on the College of Aeronautics M.S. 760 'Paris' aircraft G-APRU, in order to measure certain of the lateral derivatives. The derivatives were obtained by 'time-vector' analysis of the 'Dutch roll' oscillation: the sideslip-dependent derivatives were also measured by asymmetric and sideslip flight tests. The Dutch rolls were carried out with the aircraft in two different inertia configurations, and the differences encountered in certain of the derivatives for the two conditions are attributable to the changes in wing dihedral and wing twist caused by the weight of fuel in the wing-tip tanks in the high inertia condition. Author

N66-32111*# Technology, Inc., Dayton, Ohio.
A STATISTICAL MODEL FOR APPLICATION OF MANEUVER FLIGHT LOADS DATA TO STRUCTURAL DESIGN CRITERIA
Alan P. Berens, Larry E. Clay, and F. Joseph Giessler Aug. 1965 102 p *lts* Rept.-970-65-4
(Contract NASw-970)
(NASA-CR-76426) CFSTI: HC $3.00/MF $0.75 CSCL 01B

A study was conducted to test the feasibility of using a proposed statistical maneuver model of aircraft center-of-gravity motions to predict for a given maneuver type the distribution of maneuver load peaks at any point in an aircraft's structure. Proven feasibility of this model would permit more meaningful application of maneuver flight loads data to structural design criteria. Consequently, a statistical maneuver model was derived for a data sample consisting of 318 descending left turns selected from available F-105D eight-channel flight loads data. From this model, distributions of peak loads were predicted for the shear load at three different locations in the F-105D structure. As evidence of the feasibility of the model, the predicted distributions compared very favorably with "observed" distributions of the loads of peaks obtained from three load time histories calculated for each of the 318 maneuvers. Author

N66-32326*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
A PARAMETRIC STUDY OF FACTORS INFLUENCING THE DEEP-STALL PITCH-UP CHARACTERISTICS OF T-TAIL TRANSPORT AIRCRAFT
Bruce G. Powers Washington, NASA, Aug. 1966 28 p refs
(NASA-TN-D-3370) CFSTI: HC $2.00/MF $0.50 CSCL 01B

An analog-computer program was conducted to study the factors influencing the deep-stall pitch-up characteristics representative of T-tail transport aircraft in a clean configuration with an aft center of gravity. Six pitching-moment curves were used and included variations of deep-stall as well as initial-stall pitching-moment characteristics. A stall maneuver with specified control rates was used, with deceleration rates into the stall of 1, 3, and 5 knots per second. The effects of gusts in causing pitch-up were also investigated. The study was limited to the three longitudinal degrees of freedom. During a stall maneuver, the time available for a pilot to initiate an acceptable recovery was significantly reduced as the severity of the pitch-up in the deep-stall region was increased. A region of increased stability at the initial stall increased the time available before the pitch-up region was encountered and also provided an additional margin to prevent pitch-up due to gust penetration. If recovery from a stall maneuver was initiated as a function of angle of attack, the shape of the pitching-moment curve had only small effects on altitude losses during recovery. Author

N66-32374# Entwicklungsring Sud, Munich (West Germany).
EXPERIENCE WITH THE FLIGHT TEST INSTRUMENTATION SYSTEM OF THE VTOL AIRCRAFT VJ 101 C
Josef Herrmann [1966] 51 p refs Presented at the 4th Intern. Aerospace Instrumentation Symp., Cranfield, England, 21–24 Mar. 1966
(EWR-4-66) CFSTI: HC $2.50/MF $0.50

A discussion is presented of the performance of the flight test instrumentation systems of the VJ 101C-XI and X2 aircraft. This discussion points out the differences between the planned systems and the systems that were actually used. The accuracies achieved are assessed and it is stated that greater accuracy can only be obtained by increasing weight and costs of the airborne equipment. The ground telemetry station is discussed briefly and the status of the data reduction system is reviewed. Schematic diagrams which show the location of various system components on the aircraft are included. H.S.W.

N66-32406# Entwicklungsring Sud, Munich (West Germany).
LOW LEVEL COMMUTATION SYSTEMS
Fritz Zeitler [1966] 36 p Presented at the 4th Intern. Aerospace Instrumentation Symp., Cranfield, England, 21–24 Mar. 1966
(EWR-3-66) CFSTI: HC $2.00/MF $0.50

Detailed specifications are given for PAM and PCM commutators used in making various inflight measurements in VTOL aircraft. These specifications cover such areas as input voltage, source impedance, input impedance, overvoltage, channel to channel scatter, rise time, common mode voltage, common mode rejection, noise level, crosstalk, accuracy, and linearity. Other topics covered include utilization for measuring purposes, producers of commutators, a discussion of measurements which can be performed, and methods of measurement. C.T.C.

N66-32467# Technische Hogeschool, Delft (Netherlands). Dept. of Aeronautical Engineering.
MEASUREMENTS OF PERFORMANCE, STABILITY AND CONTROL CHARACTERISTICS IN NON-STEADY FLIGHT WITH A HIGH-ACCURACY INSTRUMENTATION SYSTEM
O. H. Gerlach Feb. 1966 45 p refs Presented at the 4th Intern. Aerospace Instrumentation Symp., Cranfield, England, 21–24 Mar. 1966
(VTH-136)

Experiments are described for testing a method for determining aircraft performance, stability- and control characteristics from measurements in non-steady flight. The method of analyzing the measured data is described. Some practical experience gained with the instrumentation system in the laboratory and in flight is described. Finally a check on the applicability of the method is made for a single-engine, propeller-driven aircraft. Author

N66-32540# Cornell Univ., Ithaca, N. Y. Daniel and Florence Guggenheim Aviation Safety Center.
SURVEY OF RESEARCH PROJECTS IN THE FIELD OF AVIATION SAFETY Annual Supplement, 1966
1966 32 p refs

Research conducted in various fields affecting aviation safety is discussed, and the most important areas for further action in research and practice are delineated as airport and navigational aids, emergency evacuation, crash fire protection, collision avoidance, air turbulence, weather information, V/STOL development, general aviation, economics of safety, and human factors. Research projects in the following areas are listed with title, brief description, sponsor, and location: accident prevention and protection, airplane design, air transportation, aviation medicine, and operating problems. These include such topics as crash research on fuel systems, fire hazards, emergency exit techniques, leakage detection, pilot education, ozone in aircraft cabins, winter hazards, improvement of night vision, airport traffic light system, runway landing aid, and system failure sensing. L.E.W.

N66-32545# Tactair Fluid Controls Corp., Bridgeport, Pa.
DESIGN OF A LIGHT AIRPLANE STABILITY AUGMENTATION SAFETY SYSTEM
James E. Gasho, Harry W. Johnson, and James D. Reyner, Jr.
Dec. 1963 56 p refs
(Contract FA-WA-4512)
(FAA-ADS-9)

CAB accident reports include a large number of cases in which the inflight structural failure of a high-performance light aircraft was apparently pilot-induced during a high speed dive permitted by pilot disorientation while flying in instrument conditions. The objective of this project is to design and build a light airplane stability augmentation safety system (SAS) to fulfill two requirements: (1) If manually selected by the pilot, SAS will have cruise-relief usefulness in preventing upsets due to pilot inattention or disorientation; and (2) if not manually selected, SAS will warn the pilot when he is approaching hazardous flight regimes and will automatically return the airplane to normal flight speeds and attitudes. This report presents the design of a light airplane stability augmentation safety system. This system algebraically sums the input parameters of indicated airspeed and rate of descent to warn the pilot and energize penumatic servo subsystems at any limiting combination of these inputs to recover the airplane to normal flight. The design is configured to make the recovery from the high speed dive or spiral while holding the airplane below the structural limits of speed and load factors. Author

N66-32546*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AERODYNAMICS OF AIRFRAME-ENGINE INTEGRATION OF SUPERSONIC AIRCRAFT
Mark R. Nichols Washington, NASA, Aug. 1966 45 p refs
(NASA-TN-D-3390) CFSTI: HC $2.00/MF $0.50 CSCL 01C

Some major aerodynamic problems involved in the design of the propulsion-system installations of advanced supersonic aircraft are reviewed from the airframe viewpoint. Consideration is given to environmental factors such as flow fields, the airframe boundary layer, airframe-inlet and inlet-inlet shock interference, and jet-airframe interference. New aerodynamic tools available to the designer are discussed and are used along with experimental data to analyze the drag minimization problem. Finally, detailed attention is given to the problem of optimizing the propulsion system itself from the standpoint of inlet and nozzle selection, flow distortion effects, handling of the various secondary airflows, and afterbody drag. Author

N66-32555*# Alpha Research, Inc., Santa Barbara, Calif.
AEROBEE 150A ROLL LOCK-IN STUDY Final Summary Report, Apr.-Nov. 1965
James E. Brunk Nov. 1965 121 p refs *Its* Rept.-65-9566-7
(Contract NAS5-9566)
(NASA-CR-76800) CFSTI: HC $3.00/MF $1.00 CSCL 01C

The near-resonant motion of the Aerobee 150A, a four-finned sounding rocket vehicle with liquid-propellant sustainer and solid-propellant booster, is investigated. Pitch-roll coupling and roll lock-in are shown to be greatly influenced by induced rolling moments resulting from both aerodynamic sources and lateral configurational asymmetry. The near-resonant motion is further complicated by the presence of an aerodynamic side moment, which can be considered as a Magnus-type moment dependent upon the aerodynamic roll angle. The various mechanisms which can produce roll lock-in or extended resonance are discussed, and the probable effect of these motions on the roll rate and angle of attack are described. It is shown that both the orientation and magnitude of the various asymmetries are important in determining the possibility of lock-in or extended resonance. Author

N66-32586# Japanese Air Self-Defense Force, Tokyo. Aero-Medical Lab.
BIBLIOGRAPHY OF AVIATION ACCIDENT IN MEDICAL ASPECTS
1 Apr. 1965 229 p refs In JAPANESE and ENGLISH
(Rept.-2) CFSTI: HC $3.75/MF $1.25

An annotated bibliography on aerospace medicine, biology, and the medical aspects of aviation accidents is presented. Subjects such as public health, social medicine and hygiene, flight safety, pilot performance, protective materials, and aircraft accident prevention are included. A.O.

N66-32641*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
THE CASE FOR INHERENT STABILITY OF HELICOPTERS
John P. Reeder, Robert J. Tapscott, and John F. Garren, Jr.
Washington, NASA [1966] 29 p refs Presented at AGARD Meeting on Helicopter Develop., Paris, 10-14 Jan. 1966
(NASA-TM-X-57798) CFSTI: HC $2.00/MF $0.50 CSCL 01D

It is stated that in advanced high performance helicopters, stability and/or control augmentation systems will be necessary; however, protection against failures of augmentation systems in the form of minimum inherent stability characteristics of the basic aircraft is required. The significance of various types of instabilities, including instability with angle of attack, instability with speed, static directional instability, and effective dihedral, are discussed in relation to flight safety. The use and limitations of stability augmentation systems are examined, and the reliability of these systems is assessed. In conclusion it is stated that stability and control augmentation may be necessary to obtain desirable handling qualities; however, if the helicopter is designed with acceptable inherent stability characteristics, failure of these systems will not destroy its mission capability or prevent a safe landing. H.S.W.

03 AUXILIARY SYSTEMS

Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines; hydraulic, pneumatic and electrical systems; actuators; and inverters. For related information see also: 09 Electronic Equipment; 22 Nuclear Engineering; and 28 Propulsion Systems.

N66-31826# Royal Aircraft Establishment, Farnborough (England).

A CONTINUOUSLY FUNCTIONING DIGITAL SPEED REGULATOR [STETIG WIRKENDER DIGITALER DREHZAHL-REGLER]

W. Leonhard and H. Muller Sep. 1965 27 p refs Transl. into ENGLISH from Elektrotech. Z. (W. Berlin), v. 83, no. 12, 1962 p 381–387

(RAE-LIB-TRANS-1134) CFSTI: HC $2.00/MF $0.50

The construction and mode of operation of a continuously functioning digital speed regulator is described. The quasi-static mode of operation depends on an implicit pulse-phase comparison of a command or input pulse train with a generated output train of pulses, superimposed on the input–output comparison. The advantages of a continously functioning control compared with a digital step control lie in the improved dynamics (no dead-time) and in the simpler mode of operation (no control system). For fine adjustment of the digital speed command signal a decade frequency divider is used. Various possible inputs are discussed e.g. via switches, position counters or measurement. The digital controller described is a fundamental piece of equipment with many applications and can be completed with auxiliary equipment as required. Applications are in paper machines, test beds, steam turbines and extrusion presses for tubes. Author

N66-31895*# Naval Ammunition Depot, Crane, Ind. Quality Evaluation Lab.

EVALUATION PROGRAM FOR SECONDARY SPACECRAFT CELLS. ACCEPTANCE TEST OF SONOTONE CORPORATION 3.5 AMPERE-HOUR SEALED NICKEL-CADMIUM CELLS

H. M. Schultz 6 Jun. 1966 16 p

(NASA Order W-11252B)

(NASA-CR-76520; QE/C-66-340) CFSTI: HC $1.00/MF $0.50 CSCL 10C

Acceptance test results are presented for 3.5 ampere-hour sealed nickel–cadmium secondary spacecraft cells. All tests were performed at an ambient between 23° and 27°C at existing relative humidity and atmospheric pressure, and consisted of phenolphthalein leak, capacity, cell short, immersion seal, overcharge, internal resistance tests. Results showed the ceramic seals of the cells to be satisfactory as evidenced by no leakers. The capacity of the cells was in the acceptable range of 2.98 to 4.41 ampere-hours after a 2-year storage. The cells are recommended for acceptance on the basis of the test results. R.N.A.

N66-31896*# Naval Ammunition Depot, Crane, Ind. Quality Evaluation Lab.

EVALUATION PROGRAM FOR SECONDARY SPACECRAFT CELLS. ACCEPTANCE TEST OF C & D BATTERIES, 5.0 AMPERE-HOUR SEALED-CALCIUM CELLS

6 Jun. 1966 15 p

(NASA Order W-11252B)

(NASA-CR-76517; QE/C-66-399) CFSTI: HC $1.00/MF $0.50 CSCL 10C

Acceptance test results are presented for five ampere-hour sealed lead–calcium secondary spacecraft cells. The tests were performed at an ambient temperature between 23° and 27°C at existing relative humidity and atmospheric pressure, and consisted of visual leak, capacity, cell short, immersion seal, overcharge, and internal resistance tests. The seals and encapsulation of the cells were not satisfactory as evidenced by nine leakers out of ten cells tested. The capacity of the cells was in the range of 4.83 to 5.50 ampere-hours. Overcharge capabilities were not satisfactory as all ten cells exceeded the on charge voltage limit of 2.50 volts per cell after 8 hours at the c/10 charging rate. On the basis of test results, the cells were not recommended for acceptance. R.N.A.

N66-31902*# Electro-Optical Systems, Inc., Pasadena, Calif.

HYDROGEN–OXYGEN ELECTROLYTIC REGENERATIVE FUEL CELLS Quarterly Report, 1 Apr.–30 Jun. 1966

M. Klein 15 Jul. 1966 51 p

(Contract NAS3-2781)

(NASA-CR-76477; EOS-4110-QL-8) CFSTI: HC $2.50/MF $0.50 CSCL 10A

During this period primary emphasis was placed on the testing of single cells with various electrode and matrix structures to improve cycle life capabilities and to obtain a better understanding of modes of deterioration of cell performance. Single cell tests of the concentration type and conventional cycling type indicated that asbestos matrices are a major factor in the performance degradations that we have observed thus far. Fabrication techniques were established for forming matrices using potassium titanate as a substitute for asbestos. These new matrices have enabled cycle life improvements above what had been previously obtained with asbestos matrices. Corrosion tests of potassium titanate with molten potassium hydroxide have shown a relatively low rate of reaction exists. Author

N66-31917# Central Lab. TNO, Delft (Netherlands).

ON THE ACCUMULATION OF GAS DURING STORAGE OF NBA-030 BATTERIES AT 45°C [GASONTWIKKELING IN NBA-030 BATTERIJEN BIJ 45°C]

R. H. W. Sieh 28 Apr. 1966 14 p ref In DUTCH

(CL-66/50; TDCK-45553) CFSTI: HC $1.00/MF $0.50

As findings indicate that much gas accumulated in fresh storage batteries, accompanied by an active modification of manganese oxide, test apparatus was developed to measure the effects of gas accumulation after a storage period of six weeks. The apparatus consists of a calibrated tube, 3 m wide and 30 to 40 cm long. The battery is placed at the bottom of the tube, and a hollow, box-shaped closed aluminum cylinder is placed on top. The elevation of the aluminum cylinder thus indicates the amount of gas which accumulates as a result of the storage. It was found that within four to seven days enough gas had accumulated in the six-week-old batteries to raise the carbon component of the battery. It also appeared that a considerable amount of gas accumulates at the bottom of the zinc container of the battery. Transl. by J.O.

N66-31932*# Weston Hydraulics, Ltd., Van Nuys, Calif. Servo Controls Group.

PNEUMATIC DIGITAL ACTUATOR FOR THRUST VECTOR CONTROL Final Technical Summary Report

25 Oct. 1965 163 p
(Contract NAS8-11388)
(NASA-CR-76471) CFSTI: HC $3.25/MF $1.00 CSCL 13G

The analysis of the feasibility of a digital actuation system for thrust vector control is discussed, and the development of a prototype actuator to prove the theories involved is described. The system concepts are defined in relation to the encoder, parallel binary digital actuator, and power servo. Systems analysis details are given, and schematics are included to illustrate the various systems and subsystems. Test results indicated that air and nitrogen will give very nearly the same performance characteristics as the gaseous hydrogen if all the metering areas are reduced by a factor of three. A comparison of the reliability calculations for the digital and analog systems demonstrated that the optimum system would be a redundant digital system. Details are also given on percent input (open loop) for velocity saturation and low pressure instability. L.E.W.

N66-32063*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

AN ATTITUDE CONTROL SYSTEM FOR THE ADVANCED ORBITING SOLAR OBSERVATORY

Paul G. Fahlstrom *In its* Publ. of Goddard Space Flight Center, 1963, Vol. II [1963] p 546–548 (See N66-32044 18-31)
CFSTI: HC $7.00/MF $5.00

Reported is the design of a fine sun sensor for the orbiting solar observatory that uses a series of rotating quartz wedges to position and control the line-of-sight attitude to one second accuracies in response to a digital command system. The digital system converts a ground command into an optical slab positional reference for the observatory by means of a sensor servo drive; commanded rotation of the optics produces a positional error signal from a photodetector that is fed into the control system until the photodetector is nulled. G.G.

N66-32080*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

CONSERVATIVE TORQUES AND MOMENTS OF INERTIA INVOLVED IN THE DESIGN OF A LABORATORY MODEL SOLAR ARRAY WITH VARIABLE PADDLE-ARM ORIENTATION

S. G. Mc Carron *In its* Publ. of Goddard Space Flight Center, 1963, Vol. II [1963] p 991–1000 (See N66-32044 18-31)
CFSTI: HC $7.00/MF $5.00

In an effort to provide design data for the construction of an electromechanical system with the two degrees of freedom required for solar paddle orientation, the following expressions were determined: (1) the total conservative torque acting at the paddle-arm-rotation axis as a function of geometry and paddle-arm angle, and (2) the moment of inertia about the paddle-arm-rotation axis for a rectangular solar paddle as a function of geometry and pitch angle. The appendices include examples of determining the paddle-arm angles at which equilibrium and maximum conservative torques occur, data tables, and curves of the derived expressions for a specific geometry. Author

N66-32148# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

THE FREQUENCY RESPONSE OF BLOCKED PNEUMATIC LINES

James Thomas Karam, Jr. (M.S. Thesis) Mar. 1966 125 p refs
(GAM/ME/66B-3; AD-632393) CFSTI: HC $4.00/MF $0.75

The amplitude frequency response (transfer gain curve) of 0.170 inch I.D. blocked pneumatic lines of the type used in flueric systems was experimentally determined. The electric-pneumatic analogy was used, in conjunction with a gain envelope technique, to develop theoretical predictions of the gain curves of blocked pneumatic lines by several theories. Correlation with experiment showed that any theory using a constant pneumatic resistance would be in error when the signal frequency was greater than a characteristic frequency of the line. A high-frequency theory, based on the work of Nichols (the linear properties of pneumatic transmission lines, Transactions of the American Society of Mechanical Engineers, no. 2, 79:583-874, 1957), was developed and, at least, predicted the resonant gains within 2 dB and the resonant frequencies within 10 percent for all signal sizes. A rapid nomographic solution for the gain curve, based on this high-frequency theory, is included. Author (TAB)

N66-32256*# Electro-Optical Systems, Inc., Pasadena, Calif.

HIGH-TEMPERATURE, ZERO-DROP THYRATRON TUBE PROGRAM Quarterly Progress Report, 1 Apr.–31 May 1966

W. J. Kearns 15 Jun. 1966 34 p Prepared for JPL
(Contracts NAS7-100; JPL-951352)
(NASA-CR-76682; EOS-7016-Q-2) CFSTI: HC $2.00/MF $0.50 CSCL 10A

Progress is reported on the development of a high temperature power conditioning system for a 150-watt thermionic converter generator consisting of thyratrons, a high temperature transformer, and associated circuitry. Efforts on the circuitry during this period were devoted primarily to improving the deionization time device circuits used for taking data. Core material for the high temperature transformer was defined, samples of high temperature insulation were obtained for testing, and resistance measurements were made on two types of insulation in vacuum at 600°C. The transformer design is nearly complete, lacking only the verification that glass insulation is acceptable for long life at high temperature in vacuum. A thyratron of cylindrical geometry was designed on the basis of earlier measurements and the results of other thermionic converter programs. R.N.A.

N66-32284*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

ANALYSIS OF SOLAR THERMOELECTRIC FLAT-PLATE GENERATORS OPERATING IN THE RANGE OF 1.0 TO 0.1 ASTRONOMICAL UNIT

William J. Bifano Washington, NASA, Aug. 1966 16 p refs
(NASA-TM-X-1263) CFSTI: HC $1.00/MF $0.50 CSCL 10A

An analysis of solar thermoelectric flat-plate generators is presented for the following mission design points: 1.0 AU (Earth), 0.722 AU (Venus), 0.388 AU (Mercury), 0.25 AU, and 0.1 AU. Both lead telluride and silicon–germanium thermoelectric materials are evaluated for the generators. With the exception of the solar absorber coatings, for which long-term performance stability has yet to be demonstrated, the panel materials chosen for the study are considered state of the art. Tilting of the thermoelectric panels from 0° (panel normal to the incident solar radiation) to a maximum of 80° is used for thermal control. The results indicate that a thermoelectric flat plate can be designed to produce as much as 104 watts per square foot (1120 W/sq m) at 0.1 AU, although a panel designed for 1.0 AU produces only about 3 watts per square foot (32.2 W/sq m). The performance of thermoelectric flat plates is strongly dependent on input solar flux, and severe variations in output power are

encountered as the system travels from Earth (1.0 AU) to design point. For a limited range of distance from the Sun beyond design point (about 60 percent of the design point distance), tilting of the panels to a maximum of 80° is useful in maintaining constant output power. Author

N66-32385# Radio Corp. of America, Lancaster, Pa. Direct Energy Conversion Dept.

THE DEVELOPMENT OF AN ADSORPTION CESIUM RESERVOIR First Quarterly Technical Report, 1 Dec. 1965–30 Nov. 1966

Mar. 1966 23 p

(Contract AT(30-1)-3642)

(NYO-3642-1) CFSTI: HC $0.50/MF $0.50

An investigation was made to develop an adsorption-type cesium reservoir for a long life thermionic converter. Investigations were made on: reservoir materials, reservoir geometries and operating temperatures, cesium coverage rates and the total quantity of cesium stored on adsorption surfaces, operation of the improved converter when utilizing single and double reservoirs, and the performance of converters incorporating adsorption reservoirs with that of converters using liquid cesium reservoirs. NSA

N66-32385# Royal Aircraft Establishment, Farnborough (England).

CONVERSION OF DIRECT CURRENT INTO ALTERNATING CURRENT OF VARIABLE FREQUENCY FOR ELECTRIC TRACTION [PREOBRAZOVANIE POSTOYANNOGO TOKA V PEREMENNYI REGULIRUEMOI CHASTOTY DLYA ELEKTRICHESKOI TYAGI]

G. P. Dolaberidze Apr. 1966 25 p refs Transl. into ENGLISH from Elektroteckhnika (USSR), no. 4, 1965 p 58–62 (RAE-LIB-TRANS-1157) CFSTI: HC $1.00/MF $0.50

Two methods of converting a direct voltage into a variable frequency (5–150 c/s) polyphase voltage for motor speed control are described using: (1) a high voltage inverter supplying a high voltage frequency converter connected to the motor by a step down transformer, and (2) a high voltage inverter coupled by a step down transformer to a medium voltage frequency converter directly coupled to the motor. A control system is proposed for varying the firing angle of the frequency converter switches which uses a transformer summation of input high frequency and output low frequency voltages with the addition of a pulse from a peaking transformer supplied at input frequency. In addition an output current transformer signal prevents firing pulses being fed to a negative bank of switches while a positive bank is conducting. Author

N66-32606*# National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Ala.

POWER SYSTEMS RESEARCH AT MSFC

1965 58 p refs *Its* Res. Achievements Rev., Ser. No. 14 (NASA-TM-X-53419) CFSTI: HC $2.50/MF $0.75 CSCL 10

CONTENTS:

1. FUEL CELL SYSTEMS R. J. Boehme p 1–9 (See N66-32607 18-03)
2. THE DEVELOPMENT OF AN IMPROVED ZINC/SILVER OXIDE BATTERY C. Graff p 11–14 (See N66-32608 18-03)
3. THE ELECTRICAL POWER SYSTEM FOR THE PEGASUS SATELLITE C. Graff p 15–16 (See N66-32609 18-03)
4. BRUSHLESS DC MOTORS D. Baker p 17–20 (See N66-32610 18-03)
5. SINGLE-ENDED SWITCHING TRANSFORMER REGULATOR D. Baker p 21–30 (See N66-32611 18-03)
6. ELECTRICAL POWER SYSTEMS STUDIES AT MSFC E. E. Dungan p 31–44 refs (See N66-32612 18-03)

N66-32607*# National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Ala.

FUEL CELL SYSTEMS

Richard J. Boehme *In its* Power Systems Res. at MSFC 1965 p 1–9 (See N66-32606 18-03) CFSTI: HC $2.50/MF $0.75

The development of fuel cells at Marshall Space Flight Center is described. Program management and organization are summarized, basic hydrogen/oxygen fuel cell phenomena are reviewed, and developments centered around the asbestos matrix and static moisture removal are described. Practical systems and subsystems are discussed and performance figures are given. Author

N66-32608*# National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Ala.

THE DEVELOPMENT OF AN IMPROVED ZINC/SILVER-OXIDE BATTERY

Charles Graff *In its* Power Systems Res. at MSFC 1965 p 11–14 (See N66-32606 18-03) CFSTI: HC $2.50/MF $0.75

Details of the investigations that led to the development of an improved primary zinc/silver-oxide battery are presented. Research was conducted in two areas, separator materials and variable factors. Results of the research are the development of a more effective separator system and an improved cell design. Author

N66-32609*# National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Ala.

THE ELECTRICAL POWER SYSTEM FOR THE PEGASUS SATELLITE

Charles Graff *In its* Power Systems Res. at MSFC 1965 p 15–16 (See N66-32606 18-03) CFSTI: HC $2.50/MF $0.75

The electrical power system developed for the Pegasus satellite is described. The power load for Pegasus is approximately 40 watts, with peaks occurring during interrogation intervals. Electrical power is provided by a photovoltaic, secondary battery power system. Solar energy conversion is accomplished with silicon solar cells. A battery with a nominal capacity of 6 ampere-hours provides power during the dark period, which varies between 35 and 15 minutes. Dual battery and recharge systems are provided. Three Pegasus satellites are now in orbit with the power systems functioning properly. Author

N66-32610*# National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Ala.

BRUSHLESS dc MOTORS

Dwight Baker *In its* Power Systems Res. at MSFC 1965 p 17–20 (See N66-32606 18-03) CFSTI: HC $2.50/MF $0.75

Two brushless dc motor systems being used extensively in many space programs are described; the basic principles of operation of each are compared. In addition, the brushless dc motor and the conventional dc motor are compared, and the major advantages of each are discussed. The present and proposed uses of brushless dc motors by MSFC are

included to indicate the major advantages and future applications of these systems. Several future research and development tasks are proposed to indicate the additional efforts needed to meet the requirements for future programs. Author

N66-32611*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
SINGLE-ENDED SWITCHING TRANSFORMER REGULATOR
Dwight Baker *In its* Power Systems Res. at MSFC 1965 p 21–30 (See N66-32606 18-03) CFSTI: HC $2.50/MF $0.75

This paper describes the theory of operation of a single-ended switching transformer regulator capable of providing a highly regulated, electrically isolated output voltage. It also discusses the principal advantages of this technique over conventional methods. Electrical design calculations and procecures are included to assist the circuit designer in designing efficient, compact, and reliable dc-to-dc converters for specific applications. The design equations consider the components as idealized and neglect insignificant terms such as the resistance of the transformer winding, voltage drop across a saturated transistor, input source impedance, etc. Because component tolerances normally introduce the greater error in the final design, this consideration is valid. Author

N66-32612*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
ELECTRICAL POWER SYSTEMS STUDIES AT MSEC
Edward E. Dungan *In its* Power Systems Res. at MSFC 1965 p 31–44 refs (See N66-32606 18-03) CFSTI: HC $2.50/MF $0.75

Electrical power systems applicable to earth orbital and to lunar surface missions are discussed. Saturn Instrument Unit lifetime extensions will require fuel cells and/or radioisotopes for primary power. Lunar surface vehicles such as the Mobile Laboratory (MOLAB) will use fuel cells that must be optimized for mass savings. Two computer programs are discussed and one is described. Author

N66-32666*# Consolidated Controls Corp., Bethel, Conn.
FLOW TEST ON MOCKED-UP CIRCUIT
C. W. Schoenfeld 1 Feb. 1966 29 p
(Contract NAS8-11951)
(NASA-CR-76975; CCC-541) CFSTI: HC $2.00/MF $0.50 CSCL 13G

Air velocities in the test section and differential pressures in various areas were measured with the impeller rotating at the maximum design speed of 3000 RPM. Velocity measurements were also obtained at several impeller speeds. The air velocity profile across the 4.5 inch diameter test section obtained with two pitot tubes spaced 90° apart shows that, while the velocity at the center was greater than 50 FPS, the profile is not as flat as desired. The reduced velocities on either side of the center are due to the vena contracta effect produced by the sharp edged entrance from the 180° turning section. The mock-up is to be modified to incorporate curved turning vanes of different radii in the turning section. Also an inducer at the impeller entrance, a diffuser at the impeller exit and an entrance section into the test section will be tried. It is anticipated that one or a combination of these modifications will produce a more satisfactory velocity profile and improve the efficiency of the air flow circuit. Author

N66-32667*# Unified Science Associates, Inc., Pasadena, Calif.
GASEOUS ELECTROLYTES FOR BATTERIES AND FUEL CELLS Seventh Quarterly Report, 21 Feb.–20 May 1966
S. Naiditch [1966] 30 p refs
(Contract NAS7-326)
(NASA-CR-76976) CFSTI: HC $2.00/MF $0.50 CSCL 10C

Stable metal amalgam/insoluble salt cells with KCl–NH_3 electrolyte were prepared and run. Concentrations of the amalgams were established by weights of the components. Cell emfs were measured at temperatures to 85°C and were stable to 0.1% over the entire range. Pb(Hg)/$PbCl_2$, Zn(Hg)/Zn Cl_2, Cd(Hg)/$CdCl_2$ and Tl(Hg)/$TlCl_2$ electrodes of 2.35, 3.89, 3.78 and 2.81 mole percent metal respectively were used. From the emf data, we find that Zn and Cd make stable, well-behaved electrodes, while phase transitions in the Pb make it less satisfactory. The Tl did not amalgamate well. Comparison of emfs of Pb(Hg)/$PbCl_2$ amalgam concentration with 1.43, 1.30, 1.24 and 1.64 mole percent lead showed a marked difference in behavior between the one and two phase amalgam electrodes. An analysis of the state of electrolytes in liquid non-aqueous solvents has been carried out. Author

N66-32670*# Martin Co., Baltimore, Md.
HEAD TO HEAD TESTS OF THE HYDRODYNAMIC SUPPORT FOR SATURN V
H. Bone, W. R. Case, and Fay T. Gordon Dec. 1965 247 p refs
(Contract NAS8-11903)
(NASA-CR-76854; ER-14036) CFSTI: HC $3.75/MF $1.50 CSCL 13G

To generate data for comparison with mathematical models, design assurance, vibration, cylinder supply panel, statis piston characteristics, and damping tests were performed on the Saturn V hydrodynamic support. The support performed in a predictable manner and in accordance with the analytical model. Although the flat bearing gaps under high load were less than predicted, and the piston viscous damping during vertical motion was higher than predicted, it was concluded that the support can be fully used for a six degree-of-freedom system of dynamic testing. Included are test procedures, instrumentation, and results obtained. Changes in components, design details, or procedures which were required to complete the study are also presented. A.O.

N66-32671*# Martin Co., Baltimore, Md.
HEAD TO HEAD TEST PROCEDURES FOR THE HYDRODYNAMIC SUPPORT OF SATURN V
[1966] 126 p
(NASA-CR-76853; ER-14035) CFSTI: HC $3.00/MF $1.00 CSCL 13G

Procedures are described for the functional tests of two hydrodynamic supports for tha Saturn V launch vehicle. The tests include cylinder flow gain and control valves, bearing separation and redundancy, vertical and lateral damping and resonance, air spring pressure, eccentric loading, sink rate, and operating ranges. Component diagrams and tables are appended. E.A.O.

N66-32676*# Texas Instruments, Inc., Dallas. Semiconductor-Components Div.
ADVANCEMENT OF THE STATE-OF-THE-ART IN THE PRODUCTION OF DRIFT FIELD SOLAR CELLS Final Project Report, 23 Jun. 1965–23 Jan. 1966
[1966] 88 p refs
(Contract NAS5-9609)
(NASA-CR-76832; TI-03-66-21) CFSTI: HC $2.50/MF $0.75 CSCL 10A

The fabrication of drift-field solar cells with improved resistance to radiation effects is studied, and a technique for profiling the concentration gradient present in the drift-field structure is presented. Experimental lots of epitaxial solar cells were prepared with varied drift-field parameters, such as location, width, and magnitude of the drift-field; however, the manufacturing conditions were held constant. Sample cells were characterized before and after irradiation, by current, voltage, and spectral response measurements. The relative behavior of the various cell groups before irradiation follows the previously developed theory for drift-field cells, but after irradiation, most cells behave as if they had no field. It is concluded that over the range of total flux considered, there appears to be little advantage in using drift-field cells. A.O.

N66-32678*# Martin Co., Baltimore, Md.
RELIABILITY ANALYSIS AND CORRECTIVE ACTION SUMMARY FOR THE SATURN V HYDRODYNAMIC SUPPORT EQUIPMENT
Nov. 1965 45 p refs
(Contract NAS8-11903)
(NASA-CR-76655; ER-14038) CFSTI: HC $2.00/MF $0.50 CSCL 13G

Technical documentation on the reliability apportionment, prediction, and assessment models is summarized. The results of the failure mode and criticality analysis, and a summary of the head to head test failures with corrective action taken are also presented. Based on generic failure rates, the failure rate analysis indicates that the support equipment has a mean-time-before-failure (MTBF) of 877 hours for the complete system. The critical components have a combined MTBF of 1270 hours, with the mechanical components of the hydraulic and pneumatic systems dominating the critical failure rates. Although the critical failure modes are distributed throughout the system, no outstanding points of unreliability were found. A.G.O.

04 BIOSCIENCES

Includes aerospace medicine, exobiology, radiation effects on biological systems; physiological and psychological factors. For related information see also: 05 Biotechnology.

N66-31386# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PROBLEMS OF THE PHYSIOLOGY AND PATHOLOGY OF THE HIGH MOUNTAINS
K. Yu. Akhmedov, I. G. Kalinicheva, and O. G. Lorents, ed. 4 Jan. 1966 290 p refs Transl. into ENGLISH of the publ. "Voprosy Fiziologii i Patologii Vysokogor'va" Dushanbe, Izd. Akad. Nauk Tadzh. SSR, 1963 195 p
(FTD-TT-65-1320/1+2; AD-631637) CFSTI: HC $6.00/MF $1.50

Conference papers are presented relating to physiological and pathological changes which occur in the high mountains originating in Tadzhikistan and Kirgizia, U.S.S.R. For individual titles see N66-31387–N66-31416. M.W.R.

N66-31387# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CHANGES IN GAS METABOLSIM IN HYPOXEMIA
A. D. Slonim *In its* Probl. of the Physiol. and Pathol. of the High Mt. 4 Jan. 1966 p 5–15 refs (See N66-31386 18-04) CFSTI: HC $6.00/MF $1.50

Changes in the oxygen demand during hypoxemia lead to the conclusion that the tissue adaptation mechanism of an organism to oxygen deficiency is closely related to the excitation state of the skeletal muscles and to metabolism in muscle tissues. Both reactive (transport) and areactive (tissue) adaptation to mountainous conditions are discussed; as are phenomena observed during exposure to these higher altitudes. Three groups of data are presented relating to the influence of hypoxemia on general gas metabolism. In one group, the problem of lowered gas metabolism is discussed when partial pressure of the atmospheric oxygen is lowered to the point at which total or partial disruption of the oxidative process in the tissues results. Another group of phenomena, observed during comparatively short stays in the mountains, is manifested in a rise in the general metabolism; a third group of observations involves a lowering of the general gas metabolism at low and medium altitudes. M.W.R.

N66-31388# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CERTAIN PECULIARITIES IN THE REACTION OF THE HUMAN ORGANISM TO RESIDENCE IN THE HIGH MOUNTAINS OF KIRGIZIA
M. M. Mirrakhimov *In its* Probl. of the Physiol. and Pathol. of the High Mt. 4 Jan. 1966 p 16–29 refs (See N66-31386 18-04) CFSTI: HC $6.00/MF $1.50

Adaptive reactions during short- and long-term residence at high altitudes are found to vary with different localities. A stay in the Tien-Shan area causes a decline in general metabolism, but is not accompanied by as distinct a reaction as by exposure to the Caucasus or Alps. It is observed that a 30-day stay at 1750 meters in the Tien-Shan mountains does not lead to change in circulatory or hematogenetic functions of 16 male students, whereas the literature indicates marked changes following similar exposure in the other mountains. When 43 young men were observed at 3300 meters, there was a consistent rise in respiration and pulse, and a decline in both systolic and diastolic pressure. Self-observations are reported for six men who spent the first three days of an expedition at 2200 meters and the next 47 days at 3200 meters. Venous pressure diminished with altitude, but arterial pressure varied with the individual. Pulse and respiration rose during the first three days, then returned to initial values; by the end of the expedition pulse rates were lower than the initial values. M.W.R.

N66-31389# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
METABOLISM AND INTERACTION OF VITAMINS UNDER THE CONDITIONS OF THE HIGH MOUNTAINS
B. M. Braginskiy *In its* Probl. of the Physiol. and Pathol. of the High Mt. 4 Jan. 1966 p 30–43 refs (See N66-31386 18-04) CFSTI: HC $6.00/MF $1.50

An attempt was made to determine the balance of riboflavin, thiamine, nicotinic acid, and abscorbic acids following large pharmacological doses of riboflavin, folic acid, biotin, and vitamin E given to inhabitants of the Eastern Pamir where the altitude is between 3200 and 4200 meters. Normally these inhabitants show a riboflavin deficiency, but a 7-day administration (50 mg internally each day) of riboflavin

produces an increase which approaches that found in a control group. Changes in blood riboflavin content are also seen following single dose and seven-day administration of vitamin E. For these people, it is stated that when prescribing large doses of vitamin E, biotin, and folic acid, it is also necessary to specify riboflavin as a supplement. Vitamin E does not noticeably affect the excretion of N-1-methylnicotinamide in the Parmiranians, while it makes such excretion disappear in a control group. There is no change in excretion following the administration of folic acid, although there is a decrease in content of the DPN oxidized form in the blood; biotin promotes a decrease in both excretion and DPN. M.W.R.

N66-31390# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

BALLISTOCARDIOGRAPHIC OBSERVATIONS UNDER THE CONDITIONS OF THE PERIOD OF ADAPTATION TO THE HIGH MOUNTAINS

I. P. Plotnikov *In its* Probl. of the Physiol. and Pathol. of the High Mt. 4 Jan. 1966 p 44–48 refs (See N66-31386 18-04) CFSTI: HC $6.00/MF $1.50

Ballistocardiographic investigations were made of 28 individuals who stayed for several months at an altitude of 4200 meters in the Parmir area. It is concluded that the cardiovascular system possesses extensive adaptive capabilities and is the first system to react to changes in the external environment. Both a quickening of the pulse and an increase in the force of the systolic surge are noted until the sixth through ninth weeks of the sojourn in the high mountains, whence these indexes began to decline. A gradual increase in the strength of the cardiac contractions takes place; and the increase in the amplitude of the diastolic wave and the H wave confirm data indicating an increase in the load on the right ventricle as a result of a rise in pressure in the pulmonary circuit. M.W.R.

N66-31391# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INFLUENCE OF MUSCULAR EXERTION ON HUMAN CUTANEOUS BLOOD FLOW UNDER LOWLAND AND MOUNTAIN CONDITIONS

B. D. Zabudskiy *In its* Probl. of the Physiol. and Pathol. of the High Mt. 4 Jan. 1966 p 49–53 refs (See N66-31386 18-04) CFSTI: HC $6.00/MF $1.50

Cutaneous capillary blood flow is found to increase in human beings exposed to an altitude of 4200 meters during the Pamir expedition, and the increase is more pronounced in practically all cases for which physical exertion is noted during the measurements. A radiometric method of studying isotope resorption is used as the index of capillary blood flow in the skin. It is noted that different types of shifts in resorption rates occur at lower altitudes; for which acceleration, slowing down, and no changes are recorded. M.W.R.

N66-31392# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

PRESSURE IN BRACHIAL AND TEMPORAL ARTERIES IN CERTAIN PSYCHIC DISORDERS AND IN HEALTHY INDIVIDUALS UNDER THE CONDITIONS OF THE WESTERN PAMIR

B. T. Mamkin and N. Ye. Shilina *In its* Probl. of the Physiol. and Pathol. of the High Mt. 4 Jan. 1966 p 54–57 refs (See N66-31386 18-04) CFSTI: HC $6.00/MF $1.50

Results of arterial blood pressure measurements are reported for both emotionally and physically disturbed and healthy individuals living in a mountainous area with altitudes between 2200 and 3100 meters. It is noted that most of the individuals who exhibited temporal hypertonia did not complain of headaches or dizziness and had no clinical symptoms of vascular disease. In almost half of the schizophrenics examined, temporal hypotonia with a low temporal-brachial index corresponded to a decrease in blood pressure in the brachial artery. There is no general agreement between pressures in the temporal and brachial arteries, and only in hypertonia do the temporal pressure and the temporal-brachial index generally increase with an increase in the systolic pressure in the brachial artery. M.W.R.

N66-31393# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

KAVETSKIY'S TEST AT VARIOUS ALTITUDES

B. D. Zabudskiy and O. G. Lorents *In its* Probl. of the Physiol. and Pathol. of the High Mt. 4 Jan. 1966 p 58–63 refs (See N66-31386 18-04) CFSTI: HC $6.00/MF $1.50

A simple skin test using trypan blue is used to study the relationship between changes in connective tissue physiology and length of stay at various altitudes, as well as the effect of descent from mountainous areas to low altitudes. Suppressed physiological behavior of the connective tissue is noted when individuals who normally live at low altitudes spend two months at an altitude of 4200 meters. The functional state of the connective tissue rises when the group descends to the initial altitude of 800 meters, although it takes two months for functioning to return to normal. M.W.R.

N66-31394# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

COMPARATIVE STUDY OF BONE-MARROW HEMATOGENESIS AND THE PERIPHERAL BLOOD IN RABBITS UNDER THE CLIMATIC AND GEOGRAPHICAL CONDITIONS OF THE EASTERN PAMIR

O. I. Andreyeva and T. G. Chernova *In its* Probl. of the Physiol. and Pathol. of the High Mt. 4 Jan. 1966 p 64–69 refs (See N66-31386 18-04) CFSTI: HC $6.00/MF $1.50

High-mountainous conditions are found to exert a stimulating influence on bone-marrow hematogenesis, which is accompanied by a significant increase in erythrocyte count in the peripheral blood, according to experiments conducted in the eastern Pamir on 32 rabbits. When the rabbits were taken from 824 meters to an altitude of 3800 meters, it was found that red stem cells were stimulated preferentially during the first 10 to 15 days at the higher altitude. The content of erythroblast elements increase, while the leukocyte-erythrocyte ratio diminishes. The bone-marrow reaction sets in during the first few days, reaches its highest level in five to 10 days, and is stabilized by the 20th day. Maximum erythrocyte, averaging a 49% increase, is on the 20th day. Hemoglobin content rises progressively and reaches a maximum, 30% increase, on the 20th day. Since the erythrocyte count increase is faster than that of the hemoglobin content, there is a diminishing in the color index. A slight increase in total leukocyte count is noted at the end of the observations. M.W.R.

N66-31395# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ON THE PROBLEM OF HEMOPOIETINS UNDER THE CONDITIONS OF THE HIGH MOUNTAINS

Yu. B. Bobodzhanov *In its* Probl. of the Physiol. and Pathol. of the High Mt. 4 Jan. 1966 p 70–74 refs (See N66-31386 18-04) CFSTI: HC $6.00/MF $1.50

Changes in peripheral blood of rabbits was studied following single 1.5-ml intramuscular injections of hemoglobin and urine from human subjects who had previously been studied at altitudes of 800 and 3600 meters. The studies on the rabbits, made at an altitude of 3600 meters, indicate that following injection of urine the reticulocyte content increased sharply rom the first day, reached a maximum on the third day, and returned to normal on the sixth or seventh day. The administration of blood serum resulted in a greater increase in reticulocytes; the highest level was reached by the fourth day, the decline began on the fifth day, and a return to normal was noted by the eighth to tenth day. The erythrocyte count and hemoglobin content increased following both injections taken from humans who lived at high altitudes. From these and similar results, it is concluded that the hematopoietic substances which appear in the serum and urine of the inhabitants of high mountainous areas are probably produced on a lifetime basis. M.W.R.

N66-31396# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

SEGMENTATION INDICES OF NUCLEI OF PERIPHERAL-BLOOD NEUTROPHILS IN THE LOCAL POPULATION OF THE EASTERN PAMIR

M. M. Mansurova and M. O. Olimbayeva *In its* Probl. of the Physiol. and Pathol. of the High Mt. 4 Jan. 1966 p 75–82 refs (See N66-31386 18-04) CFSTI: HC $6.00/MF $1.50

Examination of more than 200 native inhabitants of the eastern Pamir region where the altitude is more than 4200 meters indicates a hypersegmentation of peripheral blood neutrophils, which is shown by a high Hynek index and a right shift of the Arneth index. Similar, although less distinct, nuclear segmentation was observed in a native population living at an altitude of 860 meters. It appears that the peculiarities of the latter group are not related to either the altitude or thyroid gland functioning. M.W.R.

N66-31397# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

FUNCTIONAL STATE OF THE THYROID GLAND IN HUMAN SUBJECTS LIVING UNDER THE CONDITIONS OF THE HIGH MOUNTAINS

Yu. V. Sergeyev *In its* Probl. of the Physiol. and Pathol. of the High Mt. 4 Jan. 1966 p 83–87 refs (See N66-31386 18-04) CFSTI: HC $6.00/MF $1.50

No pathological changes were observed in the thyroid glands of 54 health individuals who spent six months at an altitude of 4200 meters and then returned to a valley at 800 meters in the eastern Pamir. The depression of thyroid activity during the stay in the mountainous area is attributed to adaptation to oxygen insufficiency. Following descent to the lower altitude and for one month after the descent, there is continued suppression in thyroid functioning. This is attributed to the inertia of the recovery processes of the thyroid gland, which is further aggravated by the relatively high temperatures and humidity observed at the lower altitude. It is noted that radioactive iodine dosages of two microcuries do not influence thyroid gland functioning. M.W.R.

N66-31398# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INFLUENCE OF CERTAIN VITAMINS ON THE EXCRETION OF 17-KETOSTEROIDS AND CHLORIDES WITH THE URINE IN LOCAL INHABITANTS OF THE EASTERN PAMIR

B. M. Braginskiy and I. M. Mirzoyev *In its* Probl. of the Physiol. and Pathol. of the High Mt. 4 Jan. 1966 p 88–94 refs (See N66-31386 18-04) CFSTI: HC $6.00/MF $1.50

Single-dose and seven-day internal treatment with 500 μg of biotin results in significant increases in excretion of 17-ketosteroids and decreased excretion in chlorides in the urine of local inhabitants of the eastern Pamir who live at an altitude of 5700 meters. This is considered to suggest that biotin has a stimulating effect on adrenal cortex functioning, and is also observed following pharmacological dosages of vitamin E. Administration of 30 mg folic acid leads to a considerable drop in excretion of 17-ketosteroids and increase in chloride excretion, apparently indicating depression of adrenal cortex functioning; similar results are obtained with pyridoxane. M.W.R.

N66-31399# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INFLUENCE OF CORTISONE ON THE REACTIVITY OF THE ORGANISM UNDER LOWLAND AND MOUNTAIN CONDITIONS

G. L. Mednik and V. A. Prokhorov *In its* Probl. of the Physiol. and Pathol. of the High Mt. 4 Jan. 1966 p 95–103 refs (See N66-31386 18-04) CFSTI: HC $6.00/MF $1.50

A sharp drop in the production of antibodies to typhoid O-antigen is observed following the administration of 5 mg subcutaneous injections of cortisone acetate to rabbits living in lowland regions. Antibody production is more sharply inhibited following similar treatment to rabbits living at 3700-meter altitudes. It is considered that cortisone and factors operating in the high mountains are synergistic with regard to influence on the organism; and that the cortisone affects not only antibody production but also the protective capabilities of the organism. M.W.R.

N66-31400# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INFLUENCE OF CORTISONE AND DESOXYCORTICOSTERONE ON COMPOSITION OF BLOOD IN RABBITS UNDER THE CONDITIONS OF THE HIGH MOUNTAINS AND LOWLANDS

T. G. Chernova *In its* Probl. of the Physiol. and Pathol. of the High Mt. 4 Jan. 1966 p 104–110 (See N66-31386 18-04) CFSTI: HC $6.00/MF $1.50

The effects of cortisone and desoxycorticosterone (DOKS) were studied in connection with the healing of wounds in rabbits at their natural habitat at about 820 meters and at an altitude of 3800 meters in the eastern Pamir region. When cortisone was administered at both high and low altitudes, there was an increase in leukocyte count during the first few days after the injury, but this count dropped off progressively so that by the 15th day there were fewer leukocytes than initially. In one group of animals treated with cortisone, the neutrophil content increased and the lymphocytes decreased under the high altitude conditions. In the control group at low altitude, changes in leukocytes were insignificant. At both altitude levels, percentage of eosinophils and monocytes remained almost unchanged. The protective reaction of the organism to injury appears to be somewhat inhibited and drawn out at high altitudes. Administration of cortisone further suppresses this reaction, while DOKS restores the reactive level to approximately that observed at low altitudes. At high altitudes there is a slow increase in erythrocyte count and hemoglobin content in the traumatized animals; this is even slower following injection of cortisone. M.W.R.

N66-31401# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INFLUENCE OF AKTG (ACTH) AND ADRENAL CORTEX HORMONE PREPARATIONS ON THE SURVIVAL OF ANIMALS UNDER THE CONDITIONS OF ACUTE OXYGEN INSUFFICIENCY

O. G. Lorents, V. I. Arav, and L. Yu. Shcherbina *In its* Probl. of the Physiol. and Pathol. of the High Mt. 4 Jan. 1966 p 111–118 refs (See N66-31386 18-04) CFSTI: HC $6.00/MF $1.50

Comparative effects of cortisone and desoxycorticosterone (DOKS) on the survival rate of rats whose adrenal glands had been removed was investigated, as was the influence of ACTH and cortisone on intact animals. Removal of the adrenals results in a sharp drop in resistance and high mortality in the animals; and cortisone administration improves this resistance, whereas DOKS does not. Stimulation of the adrenal cortex in intact animals or treatment with additional cortisone does not affect the survival rate in acute short-term hypoxia. It was found that the rats were more sensitive to oxygen insufficiency in the summer months, when large doses of cortisone lowered resistance even further. M.W.R.

N66-31402# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

STUDY OF THE PROCESS OF ADAPTATION TO HYPOXIA AND ACCLIMATIZATION TO THE CLIMATE OF THE HIGH MOUNTAINS WITH THE PURPOSE OF USING THE LATTER TO TREAT ILLNESSES ASSOCIATED WITH OXYGEN STARVATION

N. N. Sirotinin *In its* Probl. of the Physiol. and Pathol. of the High Mt. 4 Jan. 1966 p 119–137 refs (See N66-31386 18-04) CFSTI: HC $6.00/MF $1.50

A general review of the literature is presented relating to adaptation to hypoxia, acclimatization to high-mountainous climate, and treatment of diseases associated with oxygen deficiency. Some data suggest that the early stages of hypertonia might be treated at health resorts in the mountains. Both positive and negative results are reported for bronchial-asthmatics in mountainous areas. Dogs with experimental defects in both sides of the heart adapated well to hypoxia and did not develop additional pathological symptoms during a high altitude expedition. M.W.R.

N66-31403# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ON THE INFLUENCE OF HYPOXIA AND OTHER CONDITIONS PREVAILING IN THE HIGH MOUNTAINS OF TIEN-SHAN ON THE COURSE OF PSYCHIC DISORDERS

N. V. Kantorovich *In its* Probl. of the Physiol. and Pathol. of the High Mt. 4 Jan. 1966 p 138–146 refs (See N66-31386 18-04) CFSTI: HC $6.00/MF $1.50

Various psychic disorders are found to be affected differently by the climate in high-mountainous areas. Persons in manic states, recent paranoias, and some schizophrenics are found to have remissions when they are transferred to psychiatric aid stations located at an altitude of 3540 meters. No positive results are reported for depressive persons, epileptics, or those diagnosed as in stuporous states; suggesting that such psychopathological syndromes might be treated by hyperoxia, such as use of an oxygen tent. M.W.R.

N66-31404# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ON THE INFLUENCE OF THE HIGH MOUNTAINS ON THE STATE OF THE HUMAN NERVOUS SYSTEM

Ye. N. Kutchak *In its* Probl. of the Physiol. and Pathol. of the High Mt. 4 Jan. 1966 p 147–154 refs (See N66-31386 18-04) CFSTI: HC $6.00/MF $1.50

Neurological status, motor and sensory chronaxy, and the state of higher nervous activity were observed over a four-month period in 28 individuals who camped at an altitude of 4200 meters. A so-called verbometer technique and an associative experiment were employed; orthostatic and clinostatic tests were made to determine autonomic nervous system influences. Data suggest that a number of disturbances occur under high-mountainous conditions, particularly during the first few days following the change of altitude. These changes include weakening of the inhibitory process in the cerebral cortex; anomalies in the neuromuscular apparatus, such as tremors of the palpbebrae and hands and disturbances in equilibrium; reflex disturbances; and considerable changes in chronaxy and pulse frequency. The subjects appeared to make good adjustment to the high altitude because none of the initial symptoms were noted after 1-1/2 months in the mountains. It is noted, however, that some of the subjects exhibited a secondary deterioration after three months; further study is required to determine the reason for this deterioration. M.W.R.

N66-31405# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

DATA ON VARIATIONS OF HIGHER NERVOUS ACTIVITY DURING OXYGEN STARVATION

K. Yu. Akhmedov *In its* Probl. of the Physiol. and Pathol. of the High Mt. 4 Jan. 1966 p 155–171 refs (See N66-31386 18-04) CFSTI: HC $6.00/MF $1.50

The possibility of developing new conditioned reflexes is investigated in dogs subjected to the effects of oxygen starvation in an altitude chamber with a volume of about 1.5 m^3. At a simulated altitude of 3000 meters, it was possible a new type of reflex was observed during the first few days of an experiment in a dog characterized as having a weak-type higher nervous activity; but subsequently there was a decrease in the strength of the reflex. It was not possible to develop differentiation to another type of stimulus, and suppression of cortical activity was accompanied by sluggishness. Experiments conducted without simulated ascent showed the same nervous system disturbances. In a dog with exceedingly strong and balanced nervous processes, a new conditioned-reflex sterotype was developed at an altitude of 8000 meters. The pathological changes noted at various altitudes in some dogs and the high altitude tolerance and adaptation of others are considered dependent on brain cortex functional performance limit and the strength, balance, and mobility of the nervous system processes. M.W.R.

N66-31406# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

VEGETATIVE DISTURBANCES IN CERTAIN PSYCHIATRIC DISORDERS AND IN HEALTHY INDIVIDUALS UNDER THE CONDITIONS OF THE WESTERN PAMIR

B. T. Mamkin and N. Ye. Shilina *In its* Probl. of the Physiol. and Pathol. of the High Mt. 4 Jan. 1966 p 172–174 refs (See N66-31386 18-04) CFSTI: HC $6.00/MF $1.50

Position and ocular-cardiac reflex tests were run on 33 persons with neuropsychiatric disorders who were natives of a high-altitude region; and distorted reactions were obtained in almost half of the schizophrenics within this group. Bulb resorption time was found to be within the normal limits of 40 to 60 minutes for only nine of 123 subjects, who included

50 healthy and 53 disturbed persons from the same area and a control group of 20 healthy persons. Resorption times as short as 10 minutes are recorded; and it is noted that various authors attribute such shortening to local hypoxia, disturbances in connective tissue and colloid-osmotic equilibrium, as well as malfunctioning of the endocrine-autonomic system. M.W.R.

N66-31407# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INFLUENCE OF ASCENT TO A MOUNTAIN LOCALITY AND RETURN ON COMPOSITION OF HUMAN BLOOD SERUM PROTEINS

Ye. P. Smolichev *In its* Probl. of the Physiol. and Pathol. of the High Mt. 4 Jan. 1966 p 175–181 refs (See N66-31386 18-04) CFSTI: HC $6.00/MF $1.50

Twenty clinically healthy young men were examined to determine how transfer from an altitude of 850 meters to one of 4200 meters would affect the protein composition of their blood. During the first month after ascent protein concentration was found to increase; after four months this diminished, but was still above the initial value. Relative albumin concentration dropped immediately after ascent; and by the end of four months it was still below the initial value, although an increase was noted. Relative concentration of alpha and gamma globulins rose immediately and continued to be high, but beta-globulin concentration rose immediately and diminished somewhat by the end of the four months. Absolute concentration of albumin diminished after ascent; alpha and gamma globulins showed a real increase. After descent, no changes in total concentration of protein and albumins were observed; only the relative values for the beta-globulin had changed. Functional changes in the liver are considered to be involved in these changes. M.W.R.

N66-31408# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ON THE INFLUENCE OF THE COMPLEX OF FACTORS OPERATING IN THE HIGH MOUNTAINS ON THE VARIATION OF BLOOD SERUM PROTEINS UNDER X-RADIATION

Ye. P. Smolichev and Yu. T. Ponomarev *In its* Probl. of the Physiol. and Pathol. of the High Mt. 4 Jan. 1966 p 182–185 refs (See N66-31386 18-04) CFSTI: HC $6.00/MF $1.50

Fourteen rabbits were subjected to 1000 units of external X-ray irradiation under normal and subnormal barometric pressure at an altitude of 4200 meters, and 15 rabbits were given the same treatment at an altitude of 850 meters. A decrease in total concentration of serum protein and albumins was observed two weeks after X-irradiation at high altitudes, whereas no changes were noted at the lower altitude. M.W.R.

N66-31409# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CHANGES IN PROTEIN COMPOSITION OF BLOOD SERUM AND THE PROCESS OF THEIR REPLENISHMENT IN EXPERIMENT LIVER PATHOLOGY UNDER THE CONDITIONS OF THE HIGH MOUNTAINS

Yu. T. Ponomarev and G. P. Rusakova *In its* Probl. of the Physiol. and Pathol. of the High Mt. 4 Jan. 1966 p 186–190 refs (See N66-31386 18-04) CFSTI: HC $6.00/MF $1.50

Variation of blood serum protein composition was studied in 20 rabbits who were transferred from their natural habitat of 850 meters to an altitude of 4200 meters. Liver damage in the animals was caused by four subcutaneous injections of 0.5 ml/kg carbon tetrachloride given at 24-hour intervals. Simultaneously with the last injection, the animals were given 0.5 millicurie/kg of sulfur 35 in methionine. Paper electrophoresis combined with radiometry was used to study the protein fractions and S^{35} uptake. Poisoning was more severe, and usually terminated in death, at the higher altitude. Total blood serum protein concentration and beta globulins increased following CCl_4 injection at both altitudes, whereas relative content of albumins decreased. At both elevations more radioactive sulfur was taken up by the albumins than globulins. After poisoning, less S^{35} was incorporated into the albumins and beta-globulins at the higher altitude, but radioactivity was greater in the gamma-globulins. The protein-forming function of the liver is considered to be more impaired at the higher altitude. M.W.R.

N66-31410# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

DISTURBANCE OF THE BLOOD SERUM PROTEIN COMPOSITION OF RABBITS IN ACUTE RADIATION INJURY UNDER THE CONDITIONS OF THE HIGH MOUNTAINS

R. S. Rubinov *In its* Probl. of the Physiol. and Pathol. of the High Mt. 4 Jan. 1966 p 191–198 refs (See N66-31386 18-04) CFSTI: HC $6.00/MF $1.50

Shifts in blood protein composition are investigated at an altitude of 3600 meters in 10 rabbits suffering from acute beta-radiation injury following subcutaneous injection of 2.5 millicuries/g of weight of a $Na_2HP^{33}O_4$ solution. All of the animals died between the 7th and 14th days following the injection. A sharp decrease in leukocyte count is noted on the 1st through 4th days, followed by a leveling off until just before the animals perished. Erythrocyte count falls off slightly on the 6th day, and a decrease in hemoglobin content is noted at the end of the experiment. A decrease in total protein concentration is noted from the 1st day, as are both an absolute and relative decrease in serum albumins and an increase in alpha and beta globulins. While some differences are noted between effects at high and low altitudes, it is concluded that the general trend in shifts in blood serum protein composition remains the same. M.W.R.

N66-31411# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

COMPARATIVE HISTOMORPHOLOGICAL DESCRIPTION OF WOUND HEALING UNDER THE INFLUENCE OF CORTISONE AND DESOXYCORTICOSTERONE (DOKS) AT MOUNTAIN AND LOWLAND ALTITUDES

T. G. Chernova *In its* Probl. of the Physiol. and Pathol. of the High Mt. 4 Jan. 1966 p 199–204 refs (See N66-31386 18-04) CFSTI: HC $6.00/MF $1.50

Onset of inflammatory reaction was delayed in wounded rabbits taken to an altitude of 3800 meters as compared to a control group at a low altitude. When cortisone was administered to other rabbits, there was more weight loss and higher mortality among the wounded rabbits at both altitudes than among the nontreated rabbits. Rapid development of inflammation as well as wound closure followed treatment with desoxycorticosterone (DOKS). Microscopic examination revealed that on the fifth day after the wound was incurred, the group receiving cortisone exhibited alterative inflammation with necrotic phenomena; with DOKS there were beneficial vascular changes. Differences were even more pronounced on the 10th day. Analysis of histological data in connective-tissue formation indicates that healing is slower at higher altitude. Administration of cortisone results in sharp suppression of the regenerative processes, whereas DOKS

results in an acceleration of wound healing which is comparable to that which occurs at the lower altitude without treatment.
M.W.R.

N66-31412# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
FEATURES OF THE SURGICAL STAGE OF ANESTHESIA UNDER THE CONDITIONS OF THE HIGH MOUNTAINS (AN EXPERIMENTAL STUDY)
Yu. I. Datkhayev *In its* Probl. of the Physiol. and Pathol. of the High Mt. 4 Jan. 1966 p 205–211 refs (See N66-31386 18-04) CFSTI: HC $6.00/MF $1.50

Hemodynamic indices and changes in external respiration, blood gases, and alveolar and expired air is observed in anesthetized dogs who were operated on at an altitude of 3600 meters. Most of the 38 dogs used were transferred from a lower altitude where a control run was made on 20 other dogs. Poorer gas metabolism and more frequent respiration and pulse counts were obtained at the higher altitude. It is found that it is more dangerous to use ether without oxygen at the higher altitude because of a so-called altitude-anesthetic hypoxemia. Acclimatized dogs are shown to be more tolerant of this altitude-anesthetic hypoxemia than are newly transferred animals.
M.W.R.

N66-31413# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ETHER CONCENTRATION IN INSPIRED AIR AND IN THE BLOOD DURING ANESTHESIA UNDER THE CONDITIONS OF THE HIGH MOUNTAINS
Yu. I. Datkhayev *In its* Probl. of the Physiol. and Pathol. of the High Mt. 4 Jan. 1966 p 212–218 refs (See N66-31386 18-04) CFSTI: HC $6.00/MF $1.50

In order to determine optimum ether dosages for use in high-mountainous areas, an investigation was made of the ether concentration in the inspired air and in the blood of 14 transferred and seven local dogs at an altitude of 3600 meters. The animals were anesthetized with pure ether and an ether–oxygen mixture after receiving a morphine injection, and a control group of 10 dogs was similarly tested at a lower altitude. Since the density of ether vapor is considerably lower at high altitudes than in lowland areas, inhalation anesthesia must be administered with a higher ether concentration in the inspired air. If this is not done, it becomes difficult to reach the necessary anesthetized stage; in addition, altitude-anesthetic hypoxemia may result. Acclimatization of the animals appears to play no role in determining optimum ether concentration at the high altitude.
M.W.R.

N66-31414# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CERTAIN DATA FROM RESEARCH ON THE SEXUAL ACTIVITY OF WOMEN RESIDENTS UNDER THE CONDITIONS OF THE HIGH MOUNTAINS
Ye. I. Petranyuk *In its* Probl. of the Physiol. and Pathol. of the High Mt. 4 Jan. 1966 p 219–223 refs (See N66-31386 18-04) CFSTI: HC $6.00/MF $1.50

On the basis of data collected on 950 healthy females who live at altitudes of between 3600 and 4100 meters in the Murgab district of the Eastern Pamir, it is concluded that this high-mountain climate does not disturb menstrual and childbearing functions. Females ranging in age from 14 to 77 years were interviewed, with two-thirds of the group between 20 and 45 years old. It was found that the onset of menstruation comes late in women living at these high altitudes, and that no functional changes are exhibited in individuals who must ascend to high altitudes on a daily basis. Each of the permanent female mountaineers interviewed had five or more children. Premature births and stillbirths were rare, and spontaneous abortions occurred in less than one percent of the women of childbearing age. Migration from low to high altitudes does not affect the childbearing function or disturb pregnancies.
M.W.R.

N66-31415# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INFLUENCE OF MOUNTAIN CONDITIONS ON THE PHYSIOLOGICAL INDICES OF THE SADDLE HORSE
N. O. Mamin *In its* Probl. of the Physiol. and Pathol. of the High Mt. 4 Jan. 1966 p 224–234 refs (See N66-31386 18-04) CFSTI: HC $6.00/MF $1.50

Physiological responses of Karabair saddle horses which are indigenous to the mountains were observed in the state of rest and during physical exertion at altitudes of 2200–2600, 3750–3900, and 4150–4200 meters. A group of horses was driven into a valley, where the altitude was between 700 and 800 meters, so that a comparison could be made. Eight horses were examined in each of the four altitude groups; and no sex differences were found when measurements were made of body temperature, pulse and respiration frequency, hemoglobin, erythrocyte count, and reserve alkalinity. In the low and middle zones these physiological indices were found to be within the normal range for the animals at rest, but in the high altitude zone there is a quickening of pulse beat and other changes. Shifts in these clinical and hematological indices after exertion are found to increase with altitude increases. Recovery after physical exertion becomes slower as the altitude increases. It is concluded, nonetheless, that these Karabair horses are well suited to the conditions inherent in the high-mountain areas.
M.W.R.

N66-31416# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A BRIEF CHARACTERIZATION OF THE BACKGROUND OF THE KARA-DZHILGA-KRY LINE (EASTERN PAMIR)
M. M. Tadzhikov *In its* Probl. of the Physiol. and Pathol. of the High Mt. 4 Jan. 1966 p 235–264 refs (See N66-31386 18-04) CFSTI: HC $6.00/MF $1.50

Geophysical and meteorological observations were made at an altitude of more than 4200 meters to determine the physical characteristics of the Kara-Dzhilga-Kry line in the eastern Pamir. These included determinations of atmospheric pressure and humidity, air and soil temperatures, wind speed and direction, solar radiation intensity, total illumination of the horizontal plane, atmospheric electric-potential gradient, and ionization and radioactivity in the air. Various tables and graphs detail the results of this area which has low temperatures, humidity, and atmospheric pressure; high solar radiation intensity; and elevated ionization and radioactivity in the air.
M.W.R.

N66-31444# Kansas State Univ., Manhattan. Dept. of Psychology.
THE EVOLUTION OF PERCEPTUAL FRAMES OF REFERENCE
William Bevan et al May 1966 96 p refs
(Contract Nonr-3634(01))
(TR-37; TR-38; TR-39; TR-40; AD-632854) CFSTI: HC $3.00/MF $0.75

Contents: Serial Reaction Time and the Temporal Pattern of Prior Signals; Color Coding and the Potency of Anchors and Residuals in the Judgments of Size; A Quantitative Study of Relevance in the Formation of Adaptation Levels; Some Problems in Motivation from the Point of View of the Theory of Adaptation Level. TAB

N66-31493*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

CHEMICAL STUDIES ON THE ORIGIN OF LIFE

Cyril Ponnamperuma *In* VPI Proc. of the Conf. on the Exploration of Mars and Venus Aug. 1965 8 p refs (See N66-31486 18-30) CFSTI: HC $7.00/MF $1.75

A series of experiments were conducted on the synthesis of the constituents of the nucleic acid molecule and the protein molecule, during which primitive earth conditions were simulated, to investigate the chemical origin of life. Astronomical spectroscopy has revealed that the most abundant elements in our galaxy are hydrogen, helium, oxygen, nitrogen, and carbon. It has also been determined that the energies available for the synthesis or organic compounds under primitive earth conditions are ultraviolet light from the sun, electric discharges, ionizing radiation, and heat. With these conditions as a starting point, studies revealed that primary molecules or micro molecules could have arisen on the earth devoid of life. In order for these molecules to combine to give more complex arrangements, the removal of a molecule of water is required; two possible mechanisms for this reaction are described. Since it was determined that molecules of biological significance can be synthesized abiologically, it is stated that the finding of biological compounds on the surface of Mars is no indication that life exists there; however, if life is the result of the inevitable evolution of matter, life elsewhere in the universe will be chemically similar to life on earth. H.S.W.

N66-31497*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

A FUTURE AUTOMATED BIOLOGICAL LABORATORY

Vance I. Oyama *In* VPI Proc. of the Conf. on the Exploration of Mars and Venus Aug. 1965 14 p refs (See N66-31486 18-30) CFSTI: HC $7.00/MF $1.75

Facts are given to support research approaches to an automated unmanned biological laboratory for investigations of life on Mars. The specific objectives of a mission of this type are outlined, and it is stated that if these objectives are met, measurements and assays critical and pertinent to life detection may be obtained. An argument is presented that chemistry alone may not suffice to establish the existence of life; but given such complimentary physiological measurements as metabolism, growth, and reproduction, the probability of unequivocal discovery becomes greater. If data from this laboratory positively indicates the presence of racemic amino acids, it may be strongly inferred that life does not exist on Mars. Various detection techniques are discussed, and their importance in this experiment is evaluated. H.S.W.

N66-31545# National Jewish Hospital, Denver, Colo. Dept. of Experimental Immunology.

BIOCHEMICAL AND PHYSIOLOGICAL FACTORS OF THE IMMUNE RESPONSE Annual Progress Report, 1 May 1965–30 Apr. 1966

Ignatius L. Trapani, Dan H. Campbell, Laszlo Kalmar, and Thomas Mutz 1 Jun. 1966 4 p refs

(Contract Nonr-3545(00))

(AD-632894) CFSTI: HC $1.00/MF $0.50

Antibody formation in adrenalectomized rabbits at high altitude is under study. A group of rabbits were acclimatized for 30 days to 10,600 feet at Echo Lake, then bilaterally adrenalectomized. A control group of adrenalectomized rabbits was maintained in Denver. After four weeks of recuperation both groups were given a primary I.V. immunization with bovine serum albumin (BSA). Seven weeks later a secondary immunization with BSA was given. Serum samples were obtained at appropriate intervals and analyzed for precipitating antibody. high-altitude adapted and adrenalectomized rabbits exhibit a depressed primary immune response which reaches maximum titers later than high-altitude controls; the time sequence of the secondary response is similar to controls but the titers achieved are lower. TAB

N66-31639*# Smithsonian Astrophysical Observatory, Cambridge, Mass.

SELECTED STUDIES IN EXOBIOLOGY, PLANETARY ENVIRONMENTS, AND PROBLEMS RELATED TO THE ORIGIN OF LIFE Semiannual Progress Report No. 1, 1 Oct. 1965–31 Mar. 1966

Carl Sagan Jun. 1966 130 p refs

(Grant NGR-09-015-023)

(NASA-CR-76106) CFSTI: HC $4.00/MF $1.00 CSCL 06F

CONTENTS:

1. AN ANALYSIS OF THE MARINER 2 MICROWAVE OBSERVATIONS OF VENUS J. B. Pollack and C. Sagan 69 p refs (See N66-31640 18-40)

2. PROPERTIES OF THE CLOUDS OF VENUS C. Sagan and J. B. Pollack 16 p refs (See N66-31641 18-30)

3. THERMODYNAMIC EQUILIBRIA IN PLANETARY ATMOSPHERES E. R. Lippincott (Md. Univ.), R. V. Eck, M. O. Dayhoff (Natl. Biomed. Res. Found.), and C. Sagan 37 p refs (See N66-31642 18-30)

N66-31640*# Smithsonian Astrophysical Observatory, Cambridge, Mass.

AN ANALYSIS OF THE MARINER 2 MICROWAVE OBSERVATIONS OF VENUS

James B. Pollack and Carl Sagan *In its* Selected Studies in Exobiol., Planetary Environments, and Probl. Related to the Origin of Life Jun. 1966 69 p refs (See N66-31639 18-04) CFSTI: HC $4.00/MF $1.00

Limb-darkening observations of Venus by 19 mm microwave channel onboard Mariner 2 spacecraft were analyzed and compared with ground-based measurements in a hot-surface context. Peak brightness temperatures near the center of each scan, temperatures of the emitting level, and total optical depths of the microwave attenuators were related to the five following capacity models: (1) transition of CO_2 and N_2 throughout the atmosphere; (2) water vapor absorption; (3) aerosol of absorbing dust; (4) isothermal absorbing cloud layer; and (5) an aerosol of scattering particles, arbitrarily distributed with altitude. Results rendered the CO_2–N_2, the water vapor, and the absorbing dust models untenable and suggested that the observed radiation arises from a hot surface and atmosphere. G.G.

N66-31704*# Stanford Univ., Calif. Instrumentation Research Lab.

MEMBRANE SEPARATION

Jerry Lundstrom Apr. 1966 54 p refs Revised

(Grant NsG-81-60)

(NASA-CR-76431; IRL-1046, Rev.) CFSTI: HC $2.50/MF $0.50 CSCL 06F

Permeability coefficients for both glucose and carbon dioxide through a silicone rubber membrane were measured. The experimental apparatus used, and the method of analysis are described. The coefficients were used to estimate the minimum metabolic rate for the conversion of glucose to CO_2 that is detectable using carbon-14 labelled glucose. This metabolic rate can then be equated with CO_2 production rates from glucose for various microorganisms to gain insight into the sensitivity of the membrane separation device in terms of detectable numbers of microorganisms. Detectability estimates in numbers of Escherichia Coli for different values of the experimental parameters of observation time and membrane thickness were worked out and are included. The separation factor (ratio of the steady-state permeability coefficients) of the solutes CO_2 and glucose for a given membrane is discussed. The mathematical relations used for the membrane separation were previously developed and are reported in an earlier paper. L.S.

N66-31741# Federal Aviation Agency, Oklahoma City, Okla. Office of Aviation Medicine.

PHASE SHIFTS OF THE HUMAN CIRCADIAN SYSTEM AND PERFORMANCE DEFICIT DURING THE PERIODS OF TRANSITION. III: NORTH–SOUTH FLIGHT

G. T. Hauty and T. Adams Dec. 1965 14 p refs

(AM-65-30)

At periodic intervals throughout the biological day, biomedical assessments were made for a week prior to jet flight to Santiago, Chile, for 12 days at Santiago, and for a week following return to Washington, D.C. Although previous East–West and West–East flights effected a primary shift of circadian periodicity, as manifested by physiological functions, the North–South flight did not. There was, however, a significant increase of subjective fatigue, as in the other flights. The significant impairment of psychological performance produced by the East–West but not the West–East flight was not shown by the North–South flight. Author

N66-31762# Brookhaven National Lab., Upton, N. Y.

BIOLOGICAL AND MEDICAL APPLICATIONS OF RADIOACTIVATION ANALYSIS

Donald C. Borg 5 Apr. 1966 23 p refs Presented at Nederlands Atoomforum, Utrecht, 17 Mar. 1966

(Contract AT(30-2)-GEN-16)

(BNL-10130; CONF-660312-2) CFSTI: HC $1.00/MF $0.50

Applications of activation analysis in the fields of biology and medicine are reviewed, and aspects of the program at BNL are discussed. One of the most prominent applications of activation analysis to biology has been the measurement of Na, Cl, K, and P in very tiny amounts of tissue. The other major area of application in the life sciences concerns the detection of trace elements, many of which are present in protoplasm in concentrations of less than one ppm. Relative freedom from contamination has made activation analysis more accurate rather than intrinsically more sensitive in biological trace analyses. The method is compared with conventional radiochemical approaches in analyzing for one or a few elements at a time. A bibliography of 51 references is included. Author (NSA)

N66-31763# Massachusetts Inst. of Tech., Cambridge.

THE SELECTIVE DESTRUCTION OF MICRONEURONS BY LOW-DOSE IRRADIATION Annual Progress Report and Renewal Proposal with Revised Budget Estimate, Supplement I [1964] 16 p refs

(Contract AT(30-1)-3045)

(TID-22823) CFSTI: HC $1.00/MF $0.50

The multiplying and differentiating cells of the body are highly susceptible to the effects of ionizing radiation. It may be expected, therefore, that the postnatally-forming microneurons and glia cells would be selectively destroyed by exposure to low-level γ or X-irradiation. Evidence from the literature is briefly reviewed which is in agreement with this expectation. We plan to undertake experiments in which irradiation of the head (and of specific brain regions, e.g., cerebellum, hippocampus) will be combined with thymidine-^{3}H injection in order to determine quantitatively the effect of radiation on the newly-formed, migrating and differentiating cells. This technique of selective extirpation in surviving animals, moreover, will enable us to study the role of microneurons in the organization of behavior. Author (NSA)

N66-31764# Battelle-Northwest, Richland, Wash. Pacific Northwest Research Foundation.

EFFECTS OF IONIZING RADIATION ON THE TESTICULAR FUNCTION OF MAN Yearly Progress Report No. 3, 1 Jun. 1965–31 May 1966

Carl G. Heller Feb. 1966 78 p refs

(Contract AT(45-1)-1780)

(RLO-1780-1) CFSTI: HC $3.00/MF $0.75

Preliminary data from a study of the effects of X-radiation on the testicular function of man indicate that the human system is more sensitive than other mammals for which data are available. The design and calibration of X-ray equipment to deliver a uniform dose to both testes of human beings are discussed. Data are included on the effects of X-radiation doses ranging from 5 R to 600 R total urinary gonadotropins, interstitial cell stimulating hormone, 17-ketosteroids, total estrogens, urinary testosterone, seminal fluid, sperm morphology, germinal epithelium, and spermatogenesis. The timing of spermatogenesis was confirmed, and the effects of various doses of X-radiation on chromosomes were determined. The quantitation of biopsy specimens is discussed. NSA

N66-31773# Medical Biological Lab., RVO–TNO, Rijswijk (Netherlands).

SURVIVAL OF LYMPHATIC CELLS AFTER X-IRRADIATION IN MICE

O. Vos [1966] 38 p refs Sponsored in part by EURATOM

(MBL-1966-4; TDCK-45629) CFSTI: HC $2.00/MF $0.50

Experiments were conducted to determine the radiosensitivity of lymphatic cells, using reproductive integrity as a criterion for survival of the cells. Male F_1 mice were irradiated with a lethal dose of X-rays and injected with enough bone marrow cells from one of the parent strains to secure a high 30-day survival percentage. The LD_{50} for lymph node cells derived from mice of the same parent strains was determined, and survival percentages after irradiation were calculated for irradiated and nonirradiated cells. When the cells were irradiated 4 hr after injection the radiation sensitivity was not altered; however, when irradiation was delayed 24 hr after injection, a small increase in radioresistance was found. These differences did not seem to be due to changes in cellular radiosensitivitiy. No appreciable differences were observed in radiation sensitivity of lymph node and spleen cells. Intracellular recovery from radiation damage appeared to occur in lymphatic cells within 2 hr after irradiation. The graft-versus-host reaction was felt to be a reliable measure for the reproductive integrity of the lymphatic cells. L.E.W.

N66-31792# Puerto Rico Nuclear Center, Rio Piedras.
EFFECT OF WHOLE-BODY GAMMA IRRADIATION ON SYNTHESIS AND EXRETION OF GLUCURONIDES IN RATS
Jorge Chiriboga Dec. 1965 55 p refs
(Contract AT(40-1)-1833)
(PRNC-80) CFSTI: HC $3.00/MF $0.50

Urinary excretion of glucuronides and free glucuronic acids in rats was found to be increased during the first 24 hr after irradiation with 1000 R when the rats were starved for 3 days before irradiation. Duodenal tissue from whole-body irradiated rats, tested *in vitro*, had a reduced ability to conjugate anthranilic acid, going down to 30% of the control level 48 hr after irradiation. At 192 hr after irradiation the conjugation again reached the normal level. Glucose added to the medium had no effect on control tissue but increased the conjugation of irradiated tissue. DPN increased the conjugation of tissue from normal animals but had no effect on tissue from irradiated animals. Uridine diphosphate glucose (UDPG) and UDPGA had no effect on normal or irradiated tissue. In live animals given naphthalene intragastrically or anthranilic acid subcutaneously at different intervals after irradiation with 1000 R, excretion of total glucuronic acid (free plus conjugated) was the same as in the controls. Levels of beta-glucuronidase excreted in urine by starved and irradiated rats were found to increase between 48 and 72 hr after irradiation. Urinary excretion of beta-glucuronidase inhibitor in irradiated rats was found to be the same as in the controls. A machine is described for automatic step-gradient elution in column chromatography of soluble uridine nucleotides. Preliminary results are reported on the determination of their specific activity by using ^{32}P in rat tissues. Author (NSA)

N66-31794# Virginia Univ., Charlottesville. Radiobiology and Biophysics Lab.
THE EFFECTS OF DOSE RATE AND TIME OF IRRADIATION ON DNA SYNTHESIS
L. O. Chang, S. S. Williams, and W. B. Looney [1965] 7 p refs
(Contract AT(40-1)-2889)
(TID-21914) CFSTI: HC $1.00/MF $0.50

The radiosensitivity of DNA synthesis was studied in the cell cycle of regenerating rat liver. *In vivo* studies on DNA synthesis in X-irradiated 21-hr regenerating liver showed that: with a given total dose, the slower the dose rate of irradiation administered locally to the liver, the greater is the depression in DNA synthesis, in terms of DNA specific activity; a small dose of radiation (94R) produces a significant depression in DNA synthesis; and duration of irradiation is the key factor in producing this change, while the effect of dose is secondary. Therefore, it is concluded that the process of DNA synthesis is not radioresistant when low dose rates are employed. NSA

N66-31795# Virginia Univ., Charlottesville. Radiobiology and Biophysics Lab.
A STUDY OF DNA LABELED CELLS AT DIFFERENT TIMES AFTER RADIATION, PART I
W. B. Looney [1965] 12 p refs
(Contract AT(40-1)-2889)
(TID-21907) CFSTI: HC $1.00/MF $0.50

Serial removal of the four liver lobes in rats that remain after partial hepatectomy, permitted study of the effects of radiation on somatic cells as a function of time following radiation. The most significant finding of the study is a decreasing percent of labeled cells with increasing doses of radiation. Almost all of the depression of DNA synthesis was found in liver specimens taken one hour after radiation. This is understandable since the labeled thymidine is only available for this period of time. There was a parallel depression of the rate of DNA synthesis and the percent of the cells synthesizing DNA. The percent of labeled cells was reduced from 26 percent in the controls to 4.7 percent in the radiated animals. The most plausible explanation for the increasing reduction of the percent labeled cells with increasing doses of radiation is the reduction of the cells actively synthesizing DNA. Author (NSA)

N66-31796# Virginia Univ., Charlottesville. Radiobiology and Biophysics Lab.
THE DEPRESSION OF DNA SYNTHESIS, AND THE PERCENT OF CELLS SYNTHESIZING DNA IN RADIOSENSITIVE INTESTINAL CELLS AND RADIORESISTANT LIVER CELLS FOLLOWING RADIATION, PART II
W. B. Looney [1965] 12 p refs
(Contract AT(40-1)-2889)
(TID-21908) CFSTI: HC $1.00/MF $0.50

A close parallel relationship between the depression of the rate of DNA synthesis and the depression of percent labeled cells synthesizing DNA with increasing amounts of radiation, given at a constant dose rate of 300 R/min is shown. The curves for the depression of both the rate of DNA synthesis and percent labeled cells can be resolved into two components when plotted semilogarithmically. The calculated ^{37}D dose of 570 rads and 32,000 rads was greater than the ^{37}D dose of ≅100 rads for most mammalian cell lines. The inability of the cells to synthesize DNA was, therefore, taken as presumptive evidence of cell lethality. The characteristics of the curves for rates of depression of DNA synthesis in the radioresistant liver cells of rats and the radiosensitive intestinal cells are similar. The magnitude of the rate of depression is greater in most instances in the cells of the intestines as compared to the cells of the liver. This difference may be the result of differences in the kinetics of labeled thymidine incorporation into DNA in the two organs; however, these differences may be related to yet unrecognized changes in the two organs. Further studies may, therefore, lead to better understanding of differences in radiosensitivity in mammalian cells. If the assumption is made that cell lethality is related to radiation-induced genetic changes at the molecular and morphological levels, then a number of studies in both lower and higher organisms would support the concept that cell death could be mediated through the genetic material. Author (NSA)

N66-31798# Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires.
ACTION OF 50 R X-RAY DOSES ON THE REPRODUCTIVE FUNCTION OF C3H STRAIN MICE. EFFECT OF FRACTIONATION; ACTION OF REPEATED IRRADIATION ON SUCCESSIVE GENERATIONS [ACTION DE 50 R DE RAYONS X SUR LA FONCTION DE REPRODUCTION DES SOURIS DE RACE C3H. INFLUENCE DU FRACTIONNEMENT; ACTION DE LA REPETITION DES IRRADIATIONS AU COURS DES GENERATIONS SUCCESSIVES]
Denise Alix Dec. 1965 24 p refs In FRENCH
(CEA-R-2874)

The effects of X-radiation on reproduction of mice were studied. Animals were exposed to single doses of 20, 30, 40, and 50 R, and fractional doses of 50 R/total dose divided into 2, 5, 10, or 25 irradiations distributed over one month duration. The offspring were irradiated at the same doses as the parents, consanguinity being maintained. Statistical treatment of results was carried out. Results indicated that

couples receiving a single exposure of 50 R or two exposures of 25 R at one month intervals gave comparable results. Fractional doses did not produce the slightest diminution of X-ray effect; 30 R exposure brought about a decrease in fertility, with an increase in abortions. Fertility of 20 R irradiated couples remained below controls. After ten times 5 R and twenty-five times 2 R, the number of abortions was the largest. Ovarian function is particularly sensitive to X-rays; one may think that twenty-five 2 R doses give injuries conditioning non-viability of conception products, and smaller doses should produce mutations and yield births of altered genotype individuals. Author (NSA)

N66-31801# Laboratoires du Centre d'Etude de l'Energie Nucleaire, Mol (Belgium).

ACUTE AND CHRONIC EFFECTS OF RADIATIONS CONSIDERED PRIMARILY FROM THE POINT OF VIEW OF NUCLEIC ACID AND PROTEIN METABOLISM [EFFETS AIGUS ET CHRONIQUES DES RADIATIONS ENVISAGEES SURTOUT AU POINT DE VUE DU METABOLISME DES ACIDES NUCLEIQUES ET DES PROTEINES] Final Report

17 Jan. 1966 34 p refs In FRENCH

(Contract EURATOM-053-64-3 BIOB)

(EUR-2769.f)

Progress is reported on studies on the early cytochemical and biochemical effects and on the genetic effects of ionizing radiations on plants and mammalian tissues and on their modifications by radioprotectors. Emphasis was placed on studies on the effects of X-radiation on the metabolism of nucleic acids and proteins and studies on the mechanisms of action of chemical radioprotectors; the increased effectiveness of mixtures of radioprotectors; the study of the influence of radioprotectors on cell metabolism; and studies on the influence on the permeability of the cell membrane to DNA and on the translocation of DNA in different organisms (mice and plants), by means of chromatographic studies with DEAE-cellulose paper, ultracentrifugational studies in CsCl gradients, and autoradiographic studies. A list is included of 73 publications that report the findings in detail. NSA

N66-31806*# National Aeronautics and Space Administration, Washington, D. C.

PROCEEDINGS OF THE EXPERIMENTERS' INFORMATION MEETING ON THE APOLLO APPLICATIONS PROGRAM IN BIOSCIENCE

Siegfried J. Gerathewohl and Donald R. Beem, ed. (Am. Inst. of Biol. Sci.) 1966 137 p Meeting held in Washington, D. C., 22–23 Nov. 1965

(NASA-TM-X-57742) CFSTI: HC $3.00/MF $1.00 CSCL 06C

CONTENTS:

1. STATUS REPORT ON BIOSCIENCE ON GEMINI S. J. Gerathewohl p 5–16 refs (See N66-31807 18-04)

2. STATUS REPORT ON THE BIOSATELLITE D. Jenkins p 17–19 refs (See N66-31808 18-04)

3. REPORT ON APPROVED BIOSCIENCE EXPERIMENTS FOR APOLLO: EFFECTS OF WEIGHTLESSNESS ON ISOLATED HUMAN CELLS P. O'B. Montgomery, Jr. (Texas Univ.) p 21–30 refs (See N66-31809 18-04)

4. DISCUSSION AND INTERPRETATION OF THE CHANGES PROVOKED BY ZERO GRAVITY ON THE OTOLITH UNIT OF FROGS T. Gualtierotti p 31–48 refs (See N66-31810 18-04)

5. AAP CONCEPT (ENGINEERING) W. B. Taylor p 51–66 refs (See N66-31811 18-30)

6. PLANNING OF SCIENTIFIC AND TECHNICAL EXPERIMENT PAYLOADS FOR AAP T. A. George p 67–74 refs (See N66-31812 18-30)

7. SPACECRAFT INTERFACE IN APOLLO, INCLUDING APOLLO EXPERIMENTAL PALLET R. Clemence, Jr. p 75–91 refs (See N66-31813 18-31)

8. BIOSCIENCE EXPERIMENTS UNDER CONSIDERATION AND REVIEW FOR AES AND AAP S. J. Gerathewohl p 95–103 refs (See N66-31814 18-04)

9. ADVANCED BIOSCIENCE EXPERIMENTATION IN A ZERO-GRAVITY LABORATORY F. Crandall (Electro-Optical Systems) p 105–129 refs (See N66-31815 18-04)

N66-31807*# National Aeronautics and Space Administration, Washington, DC.

STATUS REPORT ON BIOSCIENCE ON GEMINI

Siegfried J. Gerathewohl *In its* Proc. of the Experimenters' Inform. Meeting on the Apollo Appl. Program in Biosci. 1966 p 5–16 (See N66-31806 18-04) CFSTI: HC $3.00/MF $1.00

The various types of bioscience experiments that have been performed during the the Gemini-3 through Gemini-7 missions are reviewed, and their objectives and results are listed. Emphasis is placed on the following studies: (1) Weightlessness effects on the processes of fertilization, cell division, and development of sea urchin eggs; (2) prolonged weightlessness effects on cell tissues of frog eggs (this experiment is in the planning stage); (3) radiation and weightlessness effects on human white blood cells radiation dosage; (4) astronaut's visual performance during flight and visual acuity from orbital altitudes; and (5) a micrometeorite experiment to collect and study the nature of interplanetary dust. G.G.

N66-31808*# National Aeronautics and Space Administration, Washington, D. C.

STATUS REPORT ON THE BIOSATELLITE

Dale Jenkins *In its* Proc. of the Experimenters' Inform. Meeting on the Apollo Appl. Program in Biosci. 1966 p 17–19 (See N66-31806 18-04) CFSTI: HC $3.00/MF $1.00

The philosophy and rationale of the U.S. biological space program on Gemini are reviewed and compared to similar efforts in the U.S.S.R. Results of decreased gravity environment, radiation combined with weightlessness, and biorhythmic changes on plants and animals seem to indicate that vibration and acceleration during launch can cause biological effects, and require baseline exposure of all experiments before actual flights take place. The author states that only weightlessness, and not zero G effects, can be studied during space travel because either the Sun's or the Earth's gravity is always present; weightlessness is defined as a free fall caused by the velocity of the spacecraft traveling at a speed that equals the gravitational pull of the Earth. G.G.

N66-31809*# Texas Univ., Dallas. Southwestern Medical School.

REPORT ON APPROVED BIOSCIENCE EXPERIMENTS FOR APOLLO: EFFECTS OF WEIGHTLESSNESS ON ISOLATED HUMAN CELLS

P. O'B. Montgomery, Jr. *In* NASA, Washington Proc. of the Experimenters' Inform. Meeting on the Apollo Appl. Program in Biosci. 1966 p 21–30 (See N66-31806 18-04) CFSTI: HC $3.00/MF $1.00

Described is a biosatellite experimental unit able to take time-lapse motion picture photographs of the phase-contrast

images of living human cells in a state of weightlessness for a period of 21 days. It contains time-lapse motion picture cameras with locked focuses, microscopes, chambers for holding cells, and media reservoirs which will automatically feed the cells on a predetermined schedule. Electronics control the action of the feed mechanism, rotate the film, and are used to maintain the proper body temperature to keep the cells warm. A similar instrument package is also shown for manned satellite experiments that contains two microscopes of different magnification to be operated by the astronauts. G.G.

N66-31810*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
DISCUSSION AND INTERPRETATION OF THE CHANGES PROVOKED BY ZERO GRAVITY ON THE OTOLITH UNIT OF FROGS
T. Gualtierotti *In* NASA. Washington Proc. of the Experimenters' Inform. Meeting on the Apollo Appl. Program in Biosci. 1966 p 31-48 (See N66-31806 18-04) CFSTI: HC $3.00/MF $1.00

Otolithic units of living frogs were studied for their biorhythmic responses to centrifugal acceleration and to parabolic zero gravity flights. Microelectrodes, implanted into the animals' vestibular nerves, obtained their electrical response impulses which were then amplified and recorded. Results from 400 otolithic units indicated different response sensitivities for most units, and it was assumed that otoliths cover basically different ranges. Comparison of otolithic accleration responses during level flights with those obtained during parabolic flights showed higher bioelectric responses for the same unit immediately after the parabolic tests. G.G.

N66-31814*# National Aeronautics and Space Administration, Washington, D. C.
BIOSCIENCE EXPERIMENTS UNDER CONSIDERATION AND REVIEW FOR AES AND AAP
Siegfried J. Gerathewohl *In its* Proc. of the Experimenters' Inform. Meeting on the Apollo Appl. Program in Biosci. 1966 p 95-103 (See N66-31806 18-04) CFSTI: HC $3.00/MF $1.00

A total of 76 bioscience experiments were reviewed for the Apollo Applications Program from areas of environmental biology, physiology, psychobiology, and exobiology. Experiments selected in environmental biology cover the genetic effects of weightlessness in such processes as fertilization, cell division, differentiation and metabolism, tissue and organ formation, and related functions. Physiological studies will investigate the dynamic processes in animal systems to supply the basis for an understanding of zero gravity phenomena in human systems. Exobiological investigations will be concerned with life migration in planetary system and the search for extraterrestrial life forms at orbital altitudes. G.G.

N66-31815*# Electro-Optical Systems, Inc., Pasadena, Calif.
ADVANCED BIOSCIENCE EXPERIMENTATION IN A ZERO-GRAVITY LABORATORY
Frank Crandall *In* NASA. Washington Proc. of the Experimenters' Inform. Meeting on the Apollo Appl. Program in Biosci. 1966 p 105-129 (See N66-31806 18-04) CFSTI: HC $3.00/MF $1.00

The concept of an advanced manned space bioscience laboratory was analyzed for its application to gravitational biology research. Potential bioscience experiments were screened for their scientific merit, their interest to the scientific community, and environmental requirements in regard to hardware and facilities. Areas that were selected for hypothetical experiments included biological transport phenomena, cell division and cytobiology. Experiments involving groups of living things covered gravitational growth, mutation, activity, and morphology of *Protista*, the role of gravitational forces in animal embryological differentiation and early morphogenesis, and the mechaniams by which gravity plays a controlling part in tropic responses and morphogenesis of plants. G.G.

N66-31873# Deutsche Versuchsanstalt für Luft- und Raumfahrt, Bad Godesberg (West Germany). Institut für Flugmedizin.
THE REACTION OF PULSE RATE AND ETHER-DECHOLIN-TIME UNDER HIGH PRESSURE [DAS VERHALTEN DER PULSFREQUENZ UND DER AETHER-DECHOLINZEIT IM UEBERDRUCK]
Ulrich Bels May 1966 64 p refs In GERMAN; ENGLISH summary
(DLR-FB-66-36; DVL-510) CFSTI: HC $2.50/MF $0.75

This report is aimed at settling the question whether the bradycardia observed by several authors during exposure to high pressure is due to a pressure rise in the pulmonary circulation. The ether- and decholin-time was determined on male subjects under 2 to 4 atu. At the same time the heart rate was evaluated electrocardiographically. In subsequent high pressure experiments with albino rats, using gas mixtures with changing oxygen partial pressure, we tried to analyze the releasing factors for the development of bradycardia under high pressure conditions. Author

N66-31941*# Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.
THE EFFECTS OF CONFINEMENT AS A FACTOR IN MANNED SPACE FLIGHT
T. M. Fraser Washington, NASA, Jul. 1966 184 p refs
(Contract NASr-115)
(NASA-CR-511) CFSTI: HC $5.00/MF $1.25 CSCL 06S

The nature of confinement is discussed in relation to isolation and sensory deprivation and the operational and experimental experience of confinement is tabulated in terms of conditions, subjects, available volume, and significant findings. The psychological response is shown to be manifested in the form of subjective emotional reactions, discomfort and, rarely, perceptual aberration; performance decrement is relatively slight. The physiological response is seen to be one of nonspecific reaction to stress accompanied by specific changes (e.g., cardiovascular deconditioning) attributable to the reduced mobility. Some adaptation seems to take place with continued confinement, but the adaptation breaks down after about 60 days. Tolerance to confinement is discussed and tolerance curves are presented indicating thresholds of acceptable and unacceptable tolerance and an intermediate zone. The curves indicate, for 30 to 60 days' confinement, about 150 cu ft of free volume per man are necessary. Tolerance is modified by habitability, work, rest, recreation, and exercise schedules. Weightlessness may improve the restrictive aspects and hence improve tolerance, but at the same time aggravate, for example, the cardiovascular decrement. Author

N66-31984# Federation of American Societies for Experimental Biology, Washington, D. C.
DIURNAL RHYTHM OF AUTONOMIC FUNCTIONS IN COSMIC FLIGHT

G. V. Altukhov, P. V. Vasil'ev, V. E. Belai, and A. D. Egorov [1965] 15 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser. Biol. (Moscow), v. 30, no. 2, 1965 p 182–187 Sponsored by Public Health Serv.
(TT-66-60412) CFSTI: HC $1.00/MF $0.50

Changes in the rate of cardiac contractions and in the systolic index in the course of the day are analyzed and considered as an indication of the state of the cardiovascular system and the body as a whole. The data are based on observations made on four Soviet cosmonauts during preflight and orbital flight periods. Diurnal changes in the pulse rate and the systolic index were evaluated by mathematical analysis of corresponding observations under identical circumstances. Changes in the diurnal rhythm of certain autonomic functions were observed during periods of prolonged weightlessness. The mechanism responsible for these changes is thought to be connected with weightlessness specifically and with nervous and emotional tension. K.W.

N66-32105# Defence Research Board, Ottawa (Ontario).
QUANTITATIVE DISTRIBUTION AND SEASONAL DYNAMICS OF ZOOPLANKTON IN THE NEWFOUNDLAND AREA
Ye. V. Vladimirskaya Apr. 1966 9 p refs Transl. into ENGLISH from Okeanol. Issled., Sb. Statei (Moscow), no. 13, 1965 p 137–142
(T-452-R; AD-632739) CFSTI: HC $1.00/MF $0.50

The material for the present communication was supplied by the Plankton collections made during the IGY by the research ship Mikhail Lomonosov (2nd, 4th, 7th and 11th voyages) and by the expeditionary vessel Sevastropol (14th voyage). The Plankton was collected with a small Juday net made of 38 silk gauze, at standard horizons from depths 500 or 1000 m to the surface. The quantitative analysis of the Zooplankton was carried out by a method developed in VNIRO (all-union scientific institute for marine fishing and oceanography.) (TAB)

N66-32117*# Hollins Coll., Va.
THE RAT'S ANTICIPATION OF DIURNAL AND A-DIURNAL FEEDING
Robert C. Bolles and Louis W. Stojkiewicz [1963] 11 p refs Submitted for Publication
(Grant NsG-396)
(NASA-CR-60224) CFSTI: HC $1.00/MF $0.50 CSCL 06C

Ss were trained to press a bar for food and then confined for 21 days to boxes where they could press at any time but where food was obtained only at regularly scheduled feeding times. Different groups were scheduled to eat on diurnal, i.e., 24-hr., cycles or on a-diurnal, 19 or 29 hr., cycles. The a-diurnal *Ss* were also born, reared and tested under 19 or 29 hr. environmental conditions to provide further stimulus support for the anticipation of feeding. Nonetheless, they failed to show any genuine temporal discrimination or anticipation of feeding. The fact that the diurnal *Ss* showed a large, clear anticipation effect indicates that when such an effect occurs it is governed by some sort of 24-hr. biological clock rather than being based upon deprivation-produced stimuli. Author

N66-32122*# California Univ., Berkeley. Space Sciences Lab.
ENZYME ACTIVITY IN TERRESTRIAL SOIL IN RELATION TO EXPLORATION OF THE MARTIAN SURFACE Fourth Semiannual Progress Report, 1 Jan.–30 Jun. 1966
J. J. Skujins and A. D. Mc Laren 12 Jul. 1966 81 p refs *Its* Ser. No. 7, Issue No. 26
(Grant NsG-704)
(NASA-CR-76549) CFSTI: HC $2.50/MF $0.75 CSCL 06M

Qualitative and quantitative tests were made for various enzyme activities in terrestrial soil for the purpose of adapting these procedures to investigations of Mars surface. Enzyme environments at interfaces and in Martian-like environments of limited water availability are being investigated. Analysis of phosphatase activity in native soils, and soils sterilized by irradiation revealed that no correlation was found between the seasonal variation in microbial numbers and phosphatase activity; however, both number and activity increased in samples of sterile, irradiated soil innoculated with native soil. Studies were initiated to elucidate the biochemical pathway of n-dodecane utilization by soil organisms. Instrumentation for the semiconductor solid state, C-14 carbon dioxide detector was developed for possible use with urea as a substrate for the detection of its catalytic (enzymatic) breakdown in a Martian environment. R.U.

N66-32127# Agricultural Research Service, Ithaca, N. Y. Northeast Branch.
DIFFUSIVE RESISTANCES AT, AND TRANSPIRATION RATES FROM LEAVES IN SITU WITHIN THE VEGETABLE CANOPY OF A CORN CROP Research Report No. 386
I. I. Impens, D. W. Stewart, L. H. Allen, Jr., and Edgar R. Lemon Jun. 1966 29 p refs Prepared in cooperation with Cornell Univ. *Its* Interim Rept.-66-1
(RR-386)

Height distributions of internal leaf diffusion resistance (r_l) and external boundary layer diffusion resistance (r_a) were evaluated in a corn crop. Both r_a and r_l increased with depth and r_a was about 10% of r_l or less. Profiles of latent heat flux density and source intensity in the crop showed that transpiration closely paralleled foliage distribution but not radiation absorption. Author

N66-32135*# St. Johns Univ., Jamaica, N. Y. Dept. of Biology.
AN INVESTIGATION OF A SONO-CHEMICAL APPROACH IN STERILIZATION PROBLEMS Fourth Semiannual Progress Report, 1 Jan.–30 Jun. 1966
Michael A. Pisano [1966] 13 p
(Grant NsG-684)
(NASA-CR-76618) CFSTI: HC $1.00/MF $0.50 CSCL 06T

The effects of airborne, ultrasonic irradiation, used in combination with prophylene oxide, on spores of *B. subtilis* var. *niger* were studied in an effort to achieve sterilization. It was found that the use of ultrasound alone significantly reduces viable counts of the spore, and that the closer the specimen to the sound source, the greater will be the bacteria kill. Factors to be considered in achieving total sterilization are: the concentration of propylene oxide employed, the period of exposure, and the irradiation distance when ultrasound is added. It was demonstrated that the combination of propylene oxide and ultrasound results in more effective kill than when either agent is used alone. R.U.

N66-32145*# Taft (Robert A.) Sanitary Engineering Center, Cincinnati, Ohio.
ECOLOGY AND THERMAL INACTIVATION OF MICROBES IN AND ON INTERPLANETARY SPACE VEHICLE COMPONENTS Fifth Quarterly Progress Report, Apr. 1–Jun. 30, 1966
Robert Angelotti Jul. 1966 22 p refs
(NASA Order R-36-015-001)
(NASA-CR-76539) CFSTI: HC $1.00/MF $0.50 CSCL 06M

D values for dry heat exposure temperatures of 115°C and 135° C were determined for *Bacillus globigii* spores encapsulated in plastic and dried on paper strips. These values are: plastic 115°C, D=15.4 hours; 135°C, D=1.4 hours; paper 135°C, D=16.1 minutes. The slope of the Decimal Reduction Time curve for spores encapsulated in Lucite and obtained by plotting the logarithms of D for 115, 125, and 135°C against temperature was calculated to be 18.5°C (33.3°F). Author

N66-32155# Aerospace Medical Div. Aeromedical Research Lab. (6571st), Holloman AFB, N. Mex.

FLUID AND SOLUTE SHIFTS ACROSS THE PERITONEAL MEMBRANE

Donald C. Van Riper Mar. 1966 30 p refs

(ARL-TR-66-9; AD-632853) CFSTI: HC $2.00/MF $0.50

Isosmotic solutions of mannitol were injected into the peritoneal cavities of 15 dogs. The volume of remaining fluid was measured at timed intervals after injection. The concentration of electrolytes quickly approached plasma levels, principal fluxes occurring during the first 2 hours. Changes in concentration reflected movement of water from the plasma into the intraperitoneal fluid which increased terminally to an average of 26.8 percent of injected volume. The osmolality of the peritoneal fluid terminally was higher than that of the plasma in all but three of the dogs. A computer method is presented for calculating the rate constants for fluxes of solutes in and out of the peritoneal cavity. Author (TAB)

N66-32166*# National Aeronautics and Space Administration, Washington, D. C.

REPORT ISSUED ON GEMINI 8 EXPERIMENTS

23 Jun. 1966 21 p

(NASA News Release-66-163) CSCL 06S

This report describes the objectives, equipment, procedures, and results of the 10 scientific, medical, and technological experiments carried on the Gemini 8 mission. Because of the short duration of the mission, data were received from only three of the experiments, and a fourth, still on the Agena target vehicle, is scheduled for later recovery. The experiments which provided data include bioassays of flight crew body fluids, frog egg growth, and a nuclear emulsion experiment. In the first experiment, two post-flight blood samples were received from each flight crew member. An inflight urine sample was collected from the command pilot, and samples taken from the crewmen after the flight. Data from the frog egg experiment indicates that when the gravitational force is near zero, fertilized frog eggs divide normally. Telemetry indicated that the nuclear emulsion experiment was working satisfactorily and had completed about 17% of its steps when the flight terminated. The experiment was not recovered from the spacecraft retrograde adapter section. R.N.A.

N66-32179# Joint Publications Research Service, Washington, D. C.

ELECTRIC SLEEP THERAPY OF HYPERTENSION

G. V. Sergeyev 30 Jun. 1966 59 p Transl. into ENGLISH of selected portions of the book "Lecheniye Elektrosnom Bol'nykh Gipertonicheskoy Bolezn'yo" Moscow, 1965

(JPRS-36279; TT-66-32712) CFSTI: $3.00

CONTENTS:

1. ELECTRONARCOSIS AND SLEEP PRODUCED BY PASSING AN ELECTRIC CURRENT THROUGH THE BRAIN p 6-16 ref

2. THERAPEUTIC USE OF SLEEP PRODUCED BY PASSING ELECTRIC CURRENT THROUGH THE BRAIN p 17-28

3. APPARATUSES USED IN SLEEP THERAPY AND METHODS USED IN PRODUCING IT p 29-38

4. MECHANISM OF THE ACTION OF SLEEP PRODUCED BY PASSING AN ELECTRIC CURRENT THROUGH THE BRAIN p 39-50

N66-32208# Federal Aviation Agency, Oklahoma City, Okla. Office of Aviation Medicine.

PROBLEMS IN AERIAL APPLICATION: A COMPARISON OF THE EFFECTS OF DIELDRIN POISONING IN COLD-ADAPTED AND ROOM-TEMPERATURE MAMMALS

George Clark Apr. 1966 13 p refs

(AM-66-5)

The effects of dieldrin poisoning on the liver were compared in cold-adapted rats and normal rats. One-fourth of the cold-adapted rats succumbed to the poisoning while all of the normal rats survived. There were minimal fat deposits in both groups, but the cold-adapted rats were least affected. By contrast, cytoplasmic RNA was altered to a greater extent in the cold-adapted rats, although with both the changes were located periportally. Another stain that is probably specific for secondary amines was increased in both treated groups but was decreased in cold adaptation. Author

N66-32262*# Naval Submarine Medical Center, Groton, Conn.

STUDIES OF CIRCADIAN CYCLES IN HUMAN SUBJECTS DURING PROLONGED ISOLATION IN A CONSTANT ENVIRONMENT USING 8-CHANNEL TELEMETRY SYSTEMS

Memorandum Report No. 66-4

Bruce R. Clegg and Karl E. Schaefer 10 Feb. 1966 13 p refs

(NASA Order R-24)

(NASA-CR-76704) CFSTI: HC $1.00/MF $0.50 CSCL 06S

The report presents experiences obtained with the use of of 8-channel telemetry systems in continuous simultaneous monitoring of six physiological functions (EEG, EKD, respiratory rate, body temperature, skin temperature, BSR) in one of two subjects during isolation experiments of two or three weeks duration. The studies were performed to determine the extent of internal desynchronization in free running circadian cycles of physiological functions, under conditions of confinement in a constant environment such as those encountered in spaceflights and underwater exploration. TAB

N66-32285*# Harvard Univ., Boston, Mass. Thorndike Memorial Lab.

A STUDY OF PHYSIOLOGICAL MECHANISMS AND INTERRELATIONS BETWEEN SYSTEMIC AND REGIONAL BLOOD VOLUME, BLOOD FLOW AND ELECTROLYTE BALANCE

Interim Progress Report

Walter H. Abelmann and Laurence E. Earley 30 Jun. 1966 10 p refs

(Grant NsG-595)

(NASA-CR-76667) CFSTI: HC $1.00/MF $0.50 CSCL 06P

Studies on the role of hemodynamics in the regulation of sodium excretion and extracellular volume were continued. Studies have shown that probably a transmission of perfusion pressure through the renal circulation is important in determining sodium reabsorption. Additional studies are being conducted on the role of renal hemodynamics in limiting sodium excretion in animals with sodium retention and the

mechanisms whereby these hemodynamic factors alter the tubular reabsorption of sodium. Studies of the role of atrial size and function in regulating sodium excretion were continued. Studies were begun in patients with arteriosclerotic heart disease and atrial fibrillation, primary myocardial disease and atrial fibrillation, and idopathic atrial fibrillation. So far, cardioversion has tended to improve sodium excretion in these patients. Some results are reported on the effect of abnormal circulatory states on the circulatory response to upright tilt. As part of an inquiry into the effects of acute changes in plasma volume on systemic hemodynamics, the hemodynamic effects of ethacrynic acid in normal subjects and in patients with congestive heart failure are being studied. R.N.A.

N66-32296*# Miami Univ., Coral Gables, Fla. Research and Teaching Center of Toxicology.

REPORT OF TOXIC EFFECTS OF FLUORINE FOLLOWING SHORT-TERM INHALATION

M. L. Kaplinger 31 May 1966 82 p

(Grant NGR-10-007-012)

(NASA-CR-76741) CFSTI: HC $2.50/MF $0.75 CSCL 06T

Exposure of experimental animals to fluorine for 1 hr and less is reported in detail. The design and construction of special equipment, including a chamber for exposure, is described, and analytical methods developed for the determination of the concentration of fluorine in air are presented. Signs of intoxication from high concentrations of fluorine in air were marked irritation of the mucous membranes of the eyes and respiratory tract and some skin irritation. At lower concentrations, there were fewer signs of intoxication: dyspnea, lethargy, red nose, and swollen eyes were observed. At even lower concentrations there were no gross signs of intoxication, and complete blood counts on these animals did not show significant changes due to fluorine. Gross pathology following high exposure was congestion, hemorrhage, and atelestasis in the lungs and some congestion and/or mottling in the liver. Following sublethal exposures, there was pathology in the lungs, liver, and kidneys. Exposure to concentrations at or below 100 ppm for 5 min, 70 ppm for 15 min, 55 ppm for 30 min, or 45 ppm for 60 min caused no apparent effects in the animals. L.E.W.

N66-32309# California Univ., Los Angeles. Dept. of Engineering.

STUDIES IN SKILLED MYOELECTRIC CONTROL Final Report, 1 Dec. 1964–30 Nov. 1965

John Lyman, Gershon Weltman, and Hilde Groth Apr. 1966 110 p refs *Its* Rept.-66-25

(Contract AF 33(616)-1969)

(AFAL-TR-66-83; AD-633-010) CFSTI: HC $4.00/MF $0.75

Myoelectric (EMG) signal spectra were investigated and defined for a variety of conditions including different conditions of effort and fatigue. Cardioelectric (ECG) elimination techniques were investigated. Two experiments with unidimensional, graduated myoelectric control simulations were conducted to determine design parameters and human response characteristics. Multi-dimensional myoelectric control experiments were designed on the basis of the results of initial studies. An ancillary study on multi-dimensional control using an electromechanical manipulator was also undertaken. The obtained results indicate that the problem of EMG control is by no means solved. Author (TAB)

N66-32407# Ministry of Labour, Belfast (Ireland).

CODE OF PRACTICE FOR THE PROTECTION OF PERSONS EXPOSED TO IONISING RADIATIONS IN RESEARCH AND TEACHING

London, HMSO, 1964 77 p refs

HMSO: 4s 6d

A safety code is given which applies to all research laboratories, research establishments and teaching laboratories in which ionizing radiations are used or radioactive substances are present. The provisions of the code relate to hazards arising from (1) any radioactive substances, whether sealed or unsealed and (2) any machines or apparatus which emit ionizing radiations, including apparatus in which charged particles are accelerated by a voltage of not less than five kilovolts. Major topics covered include administrative organization; precautions of general application; control of effectiveness of protective measures; medical supervision; special precautions of X-ray installations, sealed sources, unsealed radioactive substances, and nuclear reactors and criticality experiments; emergency procedures; and storage of sealed sources of ionizing radiations and unsealed radioactive substances. C.T.C.

N66-32408# National Defense Research Organization T.N.O., The Hague (Netherlands).

PREVENTION OF THE BONE MARROW SYNDROME IN IRRADIATED MICE. A COMPARISON OF THE RESULTS AFTER BONE MARROW SHIELDING AND BONE MARROW INOCULATION

F. A. J. de Vries and O. Vos Apr. 1966 19 p refs

(MBL-1966-3; TDCK-45628) CFSTI: HC $1.00/MF $0.50

Shielding of bone marrow in irradiated mice was compared with intravenous injection of a bone marrow cell suspension in its effectiveness to prevent a bone marrow syndrome. Three criteria were used to measure this effectiveness: (a) survival of the irradiated mouse at 30 days after irradiation; (b) repopulation of irradiated haematopoietic tissues; and (c) incidence of spleen colonies. On the basis of the number of cells involved bone marrow injection appeared to be at least 100 times more effective than bone marrow shielding. Author

N66-32441*# Naval Medical Research Inst., Bethesda, Md.

[EXPERIMENTAL INVESTIGATION OF THE MECHANISM BY WHICH FREEZING OR DRYING AND ASSOCIATED EFFECTS AFFECT LIVING CELLS]

Harold T. Meryman 14 Jun. 1966 2 p

(NASA Order R-63)

(NASA-CR-76771; NMRI-022-jo) CFSTI: HC $1.00/MF $0.50 CSCL 06C

This letter briefly describes some of the results of a study on the freezing and drying of living cells. A continuously recording calorimetric apparatus was designed and constructed which enabled a demonstration of a consistent relationship between dehydration and freezing injury and ruled out previous theories regarding the mechanical effects of ice crystals. A hypothesis was assembled for the mechanism of freezing injury and its prevention by cryoprotective agents, which explains the effect of various freezing rates and cryoprotective agents on the basis of their effects on cell dehydration. The hypothesis led to experiments which demonstrated that freezing injury seen with low concentrations of cryoprotective agents can be prevented by very slow freezing and thawing. Supercooling studied showed that temperatures of −10°C can be easily achieved and indefinitely maintained using a variety of solutes which are not toxic and, in many cases, do not penetrate the cell. These two preservation techniques are being applied to leukocytes, platelets, and certain protozoa. R.N.A.

N66-32450# Atomic Energy Commission, Idaho Falls, Idaho. Health and Safety Div.

AIRBORNE PARTICLE SIZE ANALYSIS A Composite Bibliography

J. T. Collins, Jr., W. J. Harrie, D. D. Stromberg, and J. L. Powers May 1966 37 p refs

(IDO-12051) CFSTI: HC $2.00/MF $0.50

References (325) are given to reports and journals published from approximately 1841 through 1965. The topics considered include: aerosol behavior and characteristics; aerosol generation; autoradiography; determination of particle size; and instrumentation for collection and separation. NSA

N66-32462# California Univ., Livermore. Lawrence Radiation Lab.

DEPOSITION VELOCITIES OF AEROSOLS AND VAPORS ON PASTURE GRASS

H. Leonard Fisher 14 Mar. 1966 19 p refs

(Contract W-7405-ENG-48)

(UCRL-14702) CFSTI: HC $1.00/MF $0.50

Predictive models of vapor and aerosol particle deposition velocities on grass surfaces are presented both as equations and as parametric curves that illustrate the relationship between the deposition velocity and such factors as wind speed, terrain roughness, and the terminal velocity of particles. Comparison is made with experimental results under known conditions and it is demonstrated that vapor deposition velocity can be predicted to within a factor of 3, while particle deposition velocity can be predicted to a factor of 2 or better, the accuracy increasing with increasing particle size. The deposition velocity of fallout debris was calculated both for deposition on pasture grass and fallout collectors (pot or gummed-film) at wind speeds on the order of 10 mph. These calculations indicate that the deposition velocity on pasture grass for vapors and small particles is approximately three times as great as the deposition velocity on the fallout collectors. For particles 20 microns in diameter, the calculated values are the same for both types of surfaces. Author (NSA)

N66-32464# California Univ., Berkeley. Lawrence Radiation Lab.

QUANTUM CONVERSION IN PHOTOSYNTHESIS: ELECTRON PARAMAGNETIC RESONANCE INVESTIGATIONS

R. H. Ruby Jan. 1966 61 p refs

(Contract W-7405-ENG-48)

(UCRL-16492) CFSTI: HC $3.00/MF $0.75

A review is presented on the use of electron paramagnetic resonance (EPR) in understanding the energy conversion mechanism in photosynthesis. Experiments were also performed that reflect the belief that there exits a common physical-chemical description of all biological photosynthetic systems by the choice of a single system, a purple bacterium. Reference information on biological materials is presented with reference to variables affecting the EPR signal size in the following sequence: changes in chemical environment-mutants, poisons, removal of pigments; organic oxidants and reductants, and redox potential; temperature; light dependence of the EPR signal-intensity dependence, spectral response, transient response, and quantum yield. Information on signal parameters such as shape, g-value, and spin-lattice relaxation time is also presented. It was concluded that there has been little success towards identifying specifically the physical entity that produces the EPR signal. NSA

N66-32493# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

LITERATURE INDEX OF AEROSPACE MEDICINE AND BIOASTRONAUTICS, PUBLISHED IN USSR (1964–1965)

L. I. Boreva and E. M. Zabodovskaya 18 Mar. 1966 68 p refs Transl. into ENGLISH of the publ. "Ukazatel Literatury po Aviakosmicheskoy Meditsine i Bioastronavtike, Izdannoy v SSSR (1964–1965)" Moscow, 1965

(FTD-TT-65-1661/1+4; AD-633355) CFSTI: HC $3.00/MF $0.75

A bibliography is presented of literature dealing with aerospace medicine and bioastronautics published in the Soviet Union during 1964 and 1965. Entries are presented alphabetically by author, and separately for each year, under the following headings: general aspects; biology; neuro and sensory physiology; psychology and psychiatry; biological, physiological, and psychological effects of environment factors and stresses; personnel; medical problems and pharmacology; toxicology; and man-machine integration and lift support systems. In addition to authors, only titles and sources are presented for the references. M.W.R.

N66-32494# Harvard Univ., Boston, Mass. Dept. of Anatomy.

CELL PROLIFERATION KINETICS IN THE TONGUE AND INTESTINAL EPITHELIA OF HIBERNATING DORMICE (*GLIS GLIS*) Interim Report, 5 Jan.–1 Oct. 1965

S. J. Adelstein, C. P. Lyman, and Regina C. O'Brien. Ft. Wainwright, Alaska, Arctic Aeromed. Lab., Apr. 1966 22 p refs (Contract AF 41(609)-2296; Grants PHS-AM-94219; PHS-GM-05611)

(AAL-TR-65-16; AD-633344) CFSTI: HC $1.00/MF $0.50

The investigation attempts to define the state of cellular division in epithelial populations of the hibernating dormouse Glis Glis and to describe the dynamics of the cells, response to arousal. It was found that during hibernation DNA synthesis occurs at a markedly reduced rate, but the number of epithelial cells synthesizing DNA is the same in both hibernating and active animals. Labeled mitotic figures are not seen for up to 96 hours of continuous hibernation after tritiated thymidine is administered, suggesting there is a block in G_2. In hibernation the mitotic index drops and no anaphases or telophases are seen, suggesting presence of an intermitotic block. When animals are aroused, there is a fluorishing of mitoses with appearance of anaphases, telophases and labeled mitotic figures indicating that both blocks have been relieved with a partial synchronization of proliferating cells. Author (TAB)

N66-32519# Indiana Univ., Indianapolis. Dept. of Neurology.

OXYGEN CONVULSIONS IN MAN

H. W. Gillen 1966 14 p refs Submitted for Publication

(Contracts Nonr-964(04); Nonr-4343(00))

(AD-631925) CFSTI: HC $1.00/MF $0.50

Seventy examples of acute cerebral oxygen toxicity were described. Twenty-five had convulsions as the first clinical manifestation of the toxicity. Ten had focal twitching, and thirteen more progressed to convulsions in spite of attempted immediate therapy. The convulsions were self-limited if the PO_2 was reduced to non-toxic pressures. The morbidity was minimal with retrograde amnesia as the only deficit that persisted beyond 24 hours. No deaths occurred in this series. Re-examination of the clinical data revealed only one instance where more careful pre-exposure selection may have prevented the convulsion. All exposures were at less than three atmospheres absolute, and all but four were for thirty minutes or less. Author (TAB)

N66-32520# Lyon Univ. (France). Lab. of Experimental Pathology.
SUPPRESSION OF DIFFERENT SLEEP STATES [LA SUPPRESSION DES DIFFERENTS ETATS DE SOMMEIL]
Pierre Vimont-Vicary 1965 99 p refs In FRENCH
(Grant AF-EOAR-62-67)
(AFOSR-66-0867; AD-632874) CFSTI: HC $3.00/MF $0.75

Cats with chronically implanted electrodes were selectively deprived of paradoxical sleep for 1–26 days by the swimming pool and electric shock techniques. The 'need for paradoxical sleep' was demonstrated by the progressive diminution of the intervals between attempts to enter this phase. Deprivation of this phase of sleep for more than a week produced somnolence, muscular hypotony, sexual excitement, tachycardia, and a picture resembling hallucinations. At the end of this deprivation there was a selective paradoxical sleep 'rebound,' and up to 60% of the first 6 hours was spent in this phase of sleep. Substances with an inhibitory effect on paradoxical sleep, such as atropine, monoamine oxidase inhibitors, and reserpine, were studied, and the results are discussed in light of a neurohumoral hypothesis of sleep.
Author (TAB)

N66-32561# European Atomic Energy Community, Brussels (Belgium).
INFLUENCE OF CERTAIN FACTORS ON THE NUMBER OF LEUCOCYTES IN THE BLOOD [INFLUENCE DE CERTAINS FACTEURS SUR LE NOMBRE DE LEUCOCYTES DANS LE SANG]
H. Tanguy Jun. 1966 16 p refs In FRENCH, ENGLISH summary
(EUR-2711-f) CFSTI: HC $1.00/MF $0.50

During the course of 3,518 haematological examinations at the Nuclear Research Center at Ispra, the influence of a certain number of factors on the number of leukocytes in the blood of 706 individuals was studied. The average number of leukocytes per cubic millimeter was found to be 8,218, with slight variations according to the year; there was a relatively important diminuation in 1964. The individual variations are worth noting (4.4% of the cases have an average lower than 6,000; 8.5% an average higher than 10,000); but sex has no influence on the number. This average number of leukocytes varies also according to the season for no apparent reason, with a strong rise in September, October and December. Emotions have only a slight influence, and if so, cause a rise in the number of leukocytes. Race and origin play a more important role; the Italians have a notably higher average in relation to the Germans, Belgians, French and Dutch. Individuals who received low doses of ionizing radiations were compared with those who had not been exposed to radiations, and no difference in the number of leukocytes was found.
Author

N66-32571# Federal Aviation Agency, Oklahoma City, Okla. Office of Aviation Medicine.
FATIGUE AND STRESS STUDIES: AN IMPROVED SEMI-AUTOMATED PROCEDURE FOR FLUOROMETRIC DETERMINATION OF PLASMA CATECHOLAMINES
Vincent Fiorica Apr. 1966 14 p refs
(AM-66-6)

A semiautomated technique is described for the estimation of total catecholamines in plasma by the trihydroxyindole procedure. The method utilizes conventional alumina-column chromatography for isolation of the amines. Catecholamine oxidation, tautomerization, and fluorescence detection are accomplished by an automated chemical system. Recoveries from plasma of 0.01 and 0.02 μg total catecholamines/10-ml sample were 86.4%±8.9% (SD) and 85.6%±5.8% (SD), respectively. Total catecholamine level in resting human plasma, determined by the present technique, was 0.89±0.15 (SD) μg/l.
Author

N66-32602# Joint Publications Research Service, Washington, D. C.
AEROSPACE BIOLOGY AND THE MAGNETIC FIELD
Yu. A. Kholodov 3 Aug. 1966 9 p ref Transl. into ENGLISH from Priroda (Moscow), no. 4, 1966 p 114–115
(JPRS-36820; TT-66-33250) CFSTI: $1.00

The effects of artificial weak and strong magnetic fields on biological organisms are considered. Since artificial magnetic fields may be used to protect spacecraft from ionozing radiation, protection from the fields themselves may be necessary. Some research results are reviewed, most of which were obtained through the exposure of biological subjects to increased magnetic fields. Growth changes are reported for Chlorella and sea urchin eggs. It was found that in primates there occurs a change in the activity of the nervous and cardiovascular systems. Weak magnetic fields have produced a decrease in the light flash fusion threshold of humans. An inhibition in the growth of cancer cells occurred after exposure to a magnetic field of 600 ergs. It is stated that further research will be necessary to ensure spaceflight security and to elucidate terrestrial magnetic effects.
E.A.O.

N66-32618*# Goodyear Aerospace Corp., Litchfield Park, Ariz.
SPATIAL ORIENTATION IN A WEIGHTLESS ENVIRONMENT Summary Report (Final)
Robert Mayne 15 Apr. 1966 60 p refs
(Contract NAS9-4460)
(NASA-CR-65429; GERA-1158) CFSTI: HC $2.50/MF $0.50 CSCL 06S

A summary on the various studies on functional aspects of spatial orientation in the control of body movements is presented and a theory of the separation of gravity from acceleration is amplified to explain the reactions of man in space situations. Vertical direction determination and the attempted cancellation of gravity effects by head movements evolved as most likely causes of disturbances when man transfers from an earth to a weightless environment without prior adaptive exercises. Theoretical and experimental results indicate that otoliths and semicircular canals operate synergetically to perform the directional orientations; adaptation to a rotating platform seems to be more difficult than adaptation to a slow rotating room in an earth environment. The computer model simulation of motion sickness production by rotating chair mechanics was analyzed and a physical computer design concept for a simplified situation is outlined.
G.G.

N66-32620*# Institute for Biological Research, Los Angeles, Calif.
PHYSIOLOGIC EFFECTS OF DIETARY CLAY SUPPLEMENTS Final Report, 1 Dec. 1964–15 Jun. 1965
Benjamin H. Ershoff and Gurwant S. Bajwa 19 Jul. 1965 72 p refs
(Contract NAS9-3905)
(NASA-CR-65427) CFSTI: HC $2.50/MF $0.75 CSCL 06H

Comparative effects of clay supplements in the diets of immature male rats, hamsters, mice, and miniature pigs fed a

low calcium, low protein, low fat ration were observed by increment in their body weight and microscopic structure of their long bones. Findings indicated that clay supplement prevented rachitic changes and promoted bone development in several species of young growing animals; the effects were proportional to the level of clay supplement given. Protective effects of the clay supplement when fed with casein and protein containing rations were attributed in large part to some factors other than its calcium content. G.G.

N66-32621*# Republic Aviation Corp., Farmingdale, N. Y.
EFFECT OF DIET AND ATMOSPHERE ON INTESTINAL AND SKIN FLORA. VOLUME I: EXPERIMENTAL DATA
Lorraine S. Gall and Phyllis E. Riely [1964] 232 p refs
(Contract NAS9-4172)
(NASA-CR-65437) CFSTI: HC $3.75/MF $1.25 CSCL 06M

Microbiological determinations were carried out on 2 male subjects confined in a control area for 34 days, and on a group of 6 male subjects in a chamber that was at altitude with 100% oxygen for 20 days. Minimum hygienic procedures with and without space suits and space type diets were maintained. Plate counting and serial dilution analyses of the aerobic and anaerobic samples showed a buildup of bacteria in all body areas and the environments as the experiment progressed. The buildup was greatest in those body areas where sweating occurred. Microbiological procedures identified staphylococci, or micrococci and corynebacteria as the organisms involved in bacterial buildup in the axilla, groin, and G.P. Anaerobes isolated in this study were principally from the feces with the GD types occurring more frequently during the latter part of the study. Some potentially pathogenic bacteria were isolated from some subjects, but did not cause overt illness and did not seem to transfer readily to the other subjects. G.G.

N66-32622*# Republic Aviation Div., Fairchild Hiller Corp., Farmingdale, N. Y.
EFFECT OF DIET AND ATMOSPHERE ON INTESTINAL AND SKIN FLORA. VOLUME II: LITERATURE SURVEY
Phyllis E. Riely and Lorraine S. Gall [1965] 148 p refs
(Contract NAS9-4172)
(NASA-CR-65438) CFSTI: HC $3.00/MF $1.00 CSCL 06M

A literature survey on the varied population of differing microorganisms of the human skin is presented that encompasses both aerobic and anaerobic bacteria, yeasts, molds, fungi, actinomyces, and viruses. Included are the specialized skin areas of the anal fold, axilla, external ear, eye, fingernails, scalp, toenails, and umbilicus, but excluded are microorganisms growing on mucous surfaces. Also considered are microbiological sampling studies on groups of men having been confined for various periods of time in a closed environment under ambient atmospheric as well as under 100% oxygen conditions. G.G.

N66-32637*# Naval School of Aviation Medicine, Pensacola, Fla. Aerospace Medical Inst.
BIOCHEMICAL CHANGES OCCURRING WITH ADAPTATION TO ACCELERATIVE FORCES DURING ROTATION
James F. Colehour and Ashton Graybiel 25 Apr. 1966 17 p refs
(NASA Order R-93)
(NASA-CR-76949; NAMI-959) CFSTI: HC $1.00/MF $0.50 CSCL 06S

Biochemical measures of mild stress effects due to rotation are presented as part of an habituation experiment in which four subjects were exposed to a rotation environment over a six-day period. It is pointed out that head movements out of the plane of the room's rotation were essential to generate the Coriolis forces contributing the bizarre stimulation of the semicircular canals. General symptomatology is reported including the patterns of epinephrine, norepinephrine, and corticoid excretion; variations in total leukocyte count, eosinophiles, and carbon dioxide tension; and excretion rates of calcium, sodium, and potassium. S.P.

N66-32646# Flying Personnel Research Committee, London (England).
ACCELERATION ATELECTASIS—SOME FACTORS MODIFYING ITS OCCURRENCE AND MAGNITUDE
D. H. Glaister Jan. 1965 17 p refs
(FPRC/MEMO-220) CFSTI: HC $1.00/MF $0.50

This paper attempts to define thresholds for acceleration and time below which atelectasis does not occur, and investigates the effects of temporary changes in the inspired gas composition and pressure on the development of atelectasis. Acceleration atelectasis was studied by measuring the reduction in vital capacity (VC) following centrifuge exposure to positive acceleration with subjects wearing anti-g suits and breathing 100% O_2. During acceleration, VC decreases exponentially with time and depends on the individual's susceptibility. Changing from breathing O_2 to air with the onset of plateau acceleration did not affect the degree of VC limitation which resulted and confirms the theory that the alveoli responsible are poorly ventilated. Breathing O_2 at a positive pressure of 30 cm H_2O during the plateau acceleration halved the resulting VC production in three subjects and completely prevented it in a fourth. This may be due to the fact that pressure breathing increases the Functional Residual Capacity (FRC) which increases the lower lung ventillation. The anti-g suit's action in promoting lung collapse was mediated solely through it's abdominal compression. This is thought to reduce the FRC thus decreasing the lower lung ventilation. R.N.A.

N66-32647# Japanese Air Self-Defense Force, Tokyo. Aero-Medical Lab.
BIBLIOGRAPHY OF AVIATION MEDICINE IN JAPAN
1 Jul. 1963 318 p refs In JAPANESE
CFSTI: HC $4.25/MF $1.75

An annotated bibliography of research in aviation medicine of the past 50 years is presented. Topics such as respiration, body chemistry, and noise are included. Trans. by J.T.C.

N66-32655# United Kingdom Atomic Energy Authority, Harwell (England). Health Physics and Medical Div.
THE DETERMINATION OF ACTINIUM-227 IN URINE
P. J. Gomm and J. D. Eakins Mar. 1966 27 p refs
(AERE-R-4972)

A new method for the determination of actinium-227 in urine is described. After oxidation of the urine sample with nitric acid, actinium is coprecipitated on barium sulphate. The barium sulphate is converted to carbonate, dissolved in acid and the actinium coprecipitated on ferric hydroxide to remove barium and radium. The ferric hydroxide precipitate is dissolved in a mixture of nitric and hydrochloric acids and the solution passed through an anion exchange column upon which iron, thorium and protactinium are absorbed. The column effluent which contains the actinium is essentially free from solids. Sources for alpha counting may be

prepared either by evaporation or by electrodeposition. Actinium recoveries of about 80 per cent are obtained, with good decontamination from protactinium, thorium, radium, polonium and lead. The use of actinium-228 as a tracer for actinium-227 is also discussed. A method is described for separating radium-228 from aged thorium-232 and 'milking' actinium-228 from the radium-228 as required. Author

N66-32658# United Kingdom Atomic Energy Authority, Harwell (England). Radiological Protection Div.

MAXIMUM PERMISSIBLE CONCENTRATIONS IN AIR FOR COMPOUNDS OF Pu-239

G. W. Dolphin, K. P. Duncan, H. J. Dunster, and S. Jackson Apr. 1966 18 p refs

(AHSB(RP)-R-69) HMSO: 2s 6d

The derivation of the values for $(MPC)_a$ for soluble and insoluble plutonium is briefly reviewed for the cases of bone, liver and lungs as organs of reference. In the model used for the calculation of the $(MPC)_a$ for insoluble radioactive dusts in the lung it is assumed that 12-1/2% of the inhaled radioactivity is transferred to the body fluids. This transfer could lead to a build up of radioactivity in a body organ other than the lung. However recent data both from dog experiments and from human autopsies show that this is not the case and the lung is the critical organ following inhalation of plutonium oxide. Inhaled plutonium nitrate is fairly readily transferred to the liver and bone and consequently the more restrictive $(MPC)_a$, for soluble plutonium, must be used when this compound is involved. A list of plutonium compounds is given and divided into those compounds behaving like plutonium nitrate and those behaving like plutonium oxide in the human body. Author

05 BIOTECHNOLOGY

Includes life support systems, human engineering; protective clothing and equipment; crew training and evaluation, and piloting. For related information see also: 04 Biosciences.

N66-31538# Navy Medical Neuropsychiatric Research Unit, San Diego, Calif.

ADAPTATION TO EXTREME ENVIRONMENTS: PREDICTION OF PERFORMANCE Interim Report

E. K. Eric Gunderson Apr. 1966 47 p refs

(Rept.-66-17; AD-632996) CFSTI: HC $2.00/MF $0.50

The report summarizes a series of studies concerned with environmental and psychological factors related to adjustment or performance in isolated Antarctic groups. These studies were designed to provide support for the Navy's psychiatric assessment program and to aid in selection of suitable military and civilian applicants for service at Antarctic scientific stations. Possible sources and effects of stress in this type of confined environment are considered. Methods developed for the measurement of individual and group performance are described, and results of studies conducted to evaluate the predictive validities of biographical, clinical, and personality data are presented in detail. Studies of emotional and motivational changes during the long Antarctic winter and the relationships of such changes to occupational and social roles, psychological needs, and effective work performance are reported. Author (TAB)

N66-31541# Lockheed Missiles and Space Co., Sunnyvale, Calif.

DEVELOPMENT AND TEST OF A PROTOTYPE ADVANCED BIOMEDICAL SYSTEM Final Report, 19 Oct. 1964–18 Mar. 1966

S. A. Hall and J. B. Taffe Brooks AFB, Tex., Aerospace Med. Div., Apr. 1966 229 p refs

(Contract AF 19(600)-2755)

(AMD-TR-66-1; AD-633063) CFSTI: HC $6.00/MF $1.25

The development and ground test of a non-flyable, functional prototype life-support system was undertaken. the system was designed to support a 50-pound chimpanzee, or the metabolic equivalent, for 30 days (with a safety factor of at least 3—to make 90 days) in simulated orbit. The system consisted of a sealed life cell for housing the test specimen and his metabolic support equipment plus a service module for supporting both the life cell and its environmental control system (ECS). The ECS was designed to maintain a sea-level pressure, oxygen–nitrogen environment within the life cell. Following a shakedown test to prove out the hardware without a test subject, a test series, with animals, was initiated. The test objectives were: (1) to obtain engineering data for a future Bioastronautics Flight Research Program, (2) to ascertain the psycho-physiological effects of prolonged confinement in a micro-atmosphere on the test subjects, and (3) to acquire baseline data relative to atmospheric contaminants in the environment for the time in question. A total of 25 days of animal testing was achieved in an altitude and temperature controlled chamber using four different animals. Medical problems with the animals prevented reaching the 30-day goal with a single specimen. However, the ECS operated continuously for the full 30 days without malfunction, and the life-support system successfully demonstrated its adaptability to a flight program. Author (TAB)

N66-31583# Army Personnel Research Office, Washington, D. C. Support Systems Research Lab.

TEAM PROCEDURES IN IMAGE INTERPRETATION

Stanley F. Bolin, Robert Sadacca, and Harold Martinek Dec. 1965 41 p refs *Its* Tech. Res. Note 164

(AD-480533)

Present study was one in a series concerned with the development of effective image interpreter team techniques and organization. Ten different team procedures were compared with each other and with individual interpreters on eight performance tests based on photography from four aerial surveillance missions of World War II and four missions flown during the Korean war. Degree of cooperation and working methods were systematically varied in 80 matched teams of two or three Army image interpreters. Right and wrong scores were based on a consensus of either two or three team members. Three-man teams, with individuals working independently, proved consistently superior to the average individual interpreter attaining the same level of completeness as the average individual with substantial increases in accuracy. On the eight-mission performance tests used in this experiment, the three-man independent teams had average accuracy scores ranging from 52% to 100% versus 12% to 39% for the average individual. Two-man independent teams also showed gains in accuracy but with reduced completeness compared with individual performance. Author (TAB)

N66-31621# Southampton Univ. (England). Inst. of Sound and Vibration Research.

A REVIEW OF THE ACOUSTICAL CHARACTERISTICS AFFECTING THE INTELLIGIBILITY OF SPEECH

C. G. Rice Oct. 1964 140 p refs
(ISAV-MEMO-119) CFSTI: HC $5.00/MF $1.00

This report is a review of researches which have been carried out on the acoustical characteristics (e.g. intensity, frequency, time, amplitude distortion, masking) affecting the recognition of normal speech, and speech that has had information deliberately withdrawn. The effect of these on the intelligibility from the point of view of linguistic or semantic, phonetic and physical interdependent parameters is studied. Synthetic speech, i.e. the generation of speech sounds by the carefully controlled formation and introduction of the acoustical characteristics is also briefly discussed. G.S.

N66-31644# Ling-Temco-Vought, Inc., Dallas, Tex. LTV Astronautics Div.
THERMAL TESTS OF A PROTOTYPE GEMINI EXTRA-VEHICULAR SYSTEM
F. H. Goodnight 6 Aug. 1964 58 p refs
(Rept.-00.478)

Evaluated were a prototype space suit system consisting of a Gemini pressure suit, a superinsulation coverall garment, and a prototype life support back pack for their protection capability against the thermal environments of space, and from heating due to propulsion system exhaust plumes. Obtained temperature data on the coverall indicated superinsulation conductance degradation by gas leakage from the suit into the insulation; however, its overall thermal performance was found adequate for astronaut protection. Repeated exhaust plume impingement on the right hand of the insulation garment melted the material at about 500° F during an eleven-second pulse. Tests on the portable life support system were not successful due to some control problems; but data obtained during the test indicated that the water separator functioned properly. G.G.

N66-31851*# National Aeronautics and Space Administration, Washington, D. C.
LIVING IN SPACE
[1966] 16 p
(NASA Facts, Vol. III, No. 5) GPO: $0.15 CSCL 06K

A brief non-scientific discussion is presented on the astronaut life support elements of pressure, temperature, oxygen, and water necessary for space travel. Other materials vital to life support are tabulated in pounds per day to illustrate their relation to equipment weight. An experimental working model of an orbiting space laboratory is described. The regeneration of oxygen and water are examined. Techniques for freeze-drying foods in vacuum packages are mentioned, and a sample menu is listed. Personal hygiene and waste management methods are considered, as well as the use of energy for thermal control and electricity. S.P.

N66-31885# National Aerospace Lab., Tokyo (Japan).
A STUDY OF DIAL LEGIBILITY
Noriko Miyoshi, Masanori Okabe, and Sumiko Ishikawa 1966 19 p refs In JAPANESE; ENGLISH summary
(NAL-TR-99) CFSTI: HC $1.00/MF $0.50

An experimental study was conducted on eye movement to determine its validity as an index of legibility. Movement, accuracy, and speed in dial reading are measured. The correlation between eye movement, accuracy, and speed suggests the possibility of eye movement as a good index for measuring legibility as well as accuracy and speed. Author

N66-31966# Joint Publications Research Service, Washington, D. C.
[ULTRASONICS AND INDUSTRIAL HYGIENE]
A. F. Shitskova, ed. 21 Jul. 1966 46 p refs Transl. into ENGLISH of five articles and foreword from the book "Voprosy Gigiyeny Truda i Profpatologii Pri Promyshlennom Primenenii Ul'trazvuka, Uchenyye Zapiski No. 11", Moscow, Profizdat Publishing House, 1963
(JPRS-36613; TT-66-33044) CFSTI: $2.00

Fundamental industrial health and safety problems relating to the technological use of ultrasonics are discussed, along with the biological and pathological effects on the human organism of ultrasonic vibrations. In addition, the responses of the central and peripheral nervous systems to the combined actions of ultrasonic waves and other high frequency noises are examined. Cochleovestibular disturbances during prolonged exposure to industrial ultrasonic radiation are also considered. D.T.

N66-32141*# Texas Univ., Austin. Defense Research Lab.
[STUDIES OF AUDITORY INFORMATION PROCESSING EMPHASIZING THE APPLICATION OF SIGNAL DETECTABILITY THEORY TO THE AUDITORY SENSORY RESPONSES] Semiannual Report, 1 Dec. 1965–31 May 1966 and Eighth Quarterly Status Report, 1 Mar.–31 May 1966
L. A. Jeffress 27 Jun. 1966 10 p
(NASA Order R-129; Contract Nonr-3579(04))
(NASA-CR-76560) CFSTI: HC $1.00/MF $0.50 CSCL 05H

Research progress is reviewed on several studies pertaining to auditory information processing, adaptation to brightness of flashed incremental and decremental stimuli, and effects of chromatic adaptation on color naming. Experiments conducted on listener's free response to auditory signal detection, human performance and response were measured by randomly spacing 10 signals of low detectability, 150 msec in duration, 500 Hz, within each five-minute listening period; 10 noise-alone intervals were also defined in each period. Distributions of these response latencies were separately constructed for signal-plus-noise intervals. In other experiments on signal detection versus duration for an electric ear model, a fixed-bandwidth filter was used in combination with changing time constants of the detector. The filter was followed by a linear (half-wave) detector and by an integrator with a decay time of 100 msec. A similar experiment employing a square-law rectifier (energy detector), and the same integration time constants, was somewhat more successful. R.Ll.

N66-32173# Texas Christian Univ., Fort Worth. Inst. of Behavioral Research.
RESEARCH PROGRAMS AND SPECIAL SERVICES, 1963–1964
[1964] 19 p refs

This report outlines the research programs and special services of Texas Christian University's Institute of Behavioral Research. The Institute's organization and objectives are described, staff members and faculty associates are listed, areas covered by the research programs are defined, current and recently completed projects are listed, criteria for the selection of research projects are discussed, past and planned seminars and symposia are mentioned, and a list of publications is presented. R.N.A.

N66-32187*# National Aeronautics and Space Administration, Manned Spacecraft Center, Houston, Tex.
EVALUATION AND COMPARISON OF THREE SPACE SUIT ASSEMBLIES

R. L. Jones Washington, NASA, Jul. 1966 142 p
(NASA-TN-D-3482) CFSTI: HC $4.00/MF $1.00 CSCL 06K

This report describes in detail the program by which the Manned Spacecraft Center evaluates the performance of space suits. The testing quantifies various aspects of suit design, function, operation, and man–suit-system interface. The technique evaluates the suits with a basic rationale emphasizing mission requirements, and the procedures are structured in such a manner as to maximize objectivity. Test results are presented on the evaluation of three different space suits. These results indicate the relative position of each suit in each test and the differences between suits. By a collation of these data, the various interested but not specialized technical personnel can obtain data which reveal the state of technology of space suit design and development. These data can be used by engineers in vehicle design to determine the impact on detail design of the space-suited operator. Author

N66-32201# Aerospace Medical Div. Arctic Aeromedical Lab., Fort Wainwright, Alaska.

AN/URT-21 LOCATOR BEACON JUMP TEST AND RECEPTION DISTANCES

John R. Schumann and Walter W. Millard Jan. 1966 24 p
(AAL-TR-65-23; AD-630190) CFSTI: HC $2.60/MF $0.50

The AN/URT-21 Locator Beacon and riser antenna were installed in several different locations in the B-5 Back Style and AP28S-10 parachutes. Live and dummy drop tests were conducted at altitudes of 1500 to 5000 feet in temperatures of −5°F to 29°F. Monitoring stations at a distance of 2 to 28 miles from the drop zones reported signals heard from time of parachute deployment until ground contact was made. Aircrew members wore the back style parachute with the beacon installed between the pack tray and back cushion. A study of their subjective evaluation of the comfort of this parachute was conducted in F-102, B-47 and KC-135 aircraft. After simulating ejection procedures and flying duties, aircrew members reported very minor or no discomfort and no interference with flying duties. It is recommended that beacons be installed between the pack tray and back pad, that the beacon activating button be made of rubberized material, and that the activating cord be tied on the riser. Author (TAB)

N66-32260*# Massachusetts Inst. of Tech., Cambridge. Man–Vehicle Control Lab.

STUDIES OF HUMAN DYNAMIC SPACE ORIENTATION USING TECHNIQUES OF CONTROL THEORY Status Report

L. R. Young and Y. T. Li Jun. 1966 31 p refs
(Grant NsG-577)
(NASA-CR-76709; MV-66-1) CFSTI: HC $2.00/MF $0.50 CSCL 05H

This report describes research activity on the application of control theory techniques to analytical and experimental investigations of situations requiring a human operator to maintain himself or a vehicle in a desired orientation in space. The research includes engineering descriptions of the basic biological subsystems, development of general models for the human operator as an element in the control system of multiple-loop time varying vehicle orientation systems, and application of these models to selected vehicle control problems. The investigations emphasize the dynamic orientation aspects of manual control and in particular the effects of vehicle motion as sensed by the vestibular system. R.N.A.

N66-32335*# Douglas Aircraft Co., Inc., Long Beach, Calif.

EXPERIMENTAL STUDY OF ACOUSTIC DISPLAYS OF FLIGHT PARAMETERS IN A SIMULATED AEROSPACE VEHICLE

Darryl Katz, Jerry A. Emery, Richard F. Gabriel, and Alan A. Burrows Washington, NASA, Jul. 1966 162 p refs
(Contract NAS4-664)
(NASA-CR-509) CFSTI: HC $5.00/MF $1.00 CSCL 05H

This research was conducted to evaluate the feasibility of using acoustic stimuli in presenting information to humans. In particular, applications of acoustic displays of target location in target detection and of flight parameters in aerospace vehicles were examined. A simulated target detection task was devised and provisions made to display the lateral location of simulated targets acoustically using an interrupted 500 cycle/sec tone emanating from the target direction. The same information could be displayed visually on a meter or simultaneously by both acoustic and visual displays. Subjects engaged in the target detection task, requiring target location and identification, were concurrently involved in a visual tracking task. A secondary acoustic task was superimposed during some trials. In general, performance under acoustic display conditions was as good or better than performance under the conventional visual display condition. There were some indications of the superiority of the command visual display. There were no consistent indications of advantages related to augmentation of the acoustic displays. R.N.A.

N66-32401# Joint Publications Research Service, Washington, D. C.

PROGRAMMED LEARNING. PROGRAMMED TEXTBOOKS. TEACHING MACHINES

A. V. Prokof'yev 19 May 1966 146 p refs Transl. into ENGLISH of the book "Programmirovanoye Obucheniye. Programmirovannyye Uchbniki Machiny Dlya Obucheniya" Moscow, Military Publ. House of the Ministry of Defense USSR, 1965 p 3–162
(JPRS-35612; TT-66-32047) CFSTI: $4.00

A thorough discussion is presented on the increasing use of programmed learning, programmed textbooks, and teaching machines in the Soviet Union. The document discusses programmed learning as a means of perfecting the learning process, the processing of educational material for programmed textbooks, programmed textbooks and teaching aids, preparing study material for use in teaching machines, the classification and descriptions of teaching machines, the description of an automated class and its teaching complex, and the experience acquired in the use of teaching machines and programmed textbooks. R.N.A.

N66-32508# Berkeley Inst. of Psychological Research, San Francisco, Calif.

BEHAVIORAL RESEARCH DURING THE 1963 AMERICAN MOUNT EVEREST EXPEDITION

James T. Lester, Jr. Jul. 1965 40 p refs
(Contract Nonr-4672(00))
(TR-2; AD-619531) CFSTI: HC $2.00/MF $0.50

The report summarizes a second aspect of the behavioral research done on the 1963 American Mt. Everest Expedition, viz., a testing of hypotheses proposed by Theodore Newcomb concerning the processes through which emerge a set of stable relationships among a group of initial strangers. It also reports the results of relating predicted compatibility (predictions based on test results from the Fundamental Interpersonal Relations Orientation inventory) to self-rated

compatibility. On the whole the Newcomb hypotheses were supported. Results regarding compatibility were negative. Author (TAB)

N66-32535# Marine Engineering Lab., Annapolis, Md.
EVALUATION OF FUNCTIONAL PERFORMANCE OF AN INTEGRATED SHIP CONTROL CONNING CONSOLE BY OPERATOR PERSONNEL
J. T. Mc Lane, W. J. Weingartner, and J. C. Townsend May 1966 54 p refs
(MEL-333/65; AD-482211)

The adequacy of the human engineering for a ship control conning console static mock-up was evaluated by six naval officers and three enlisted personnel. The console was designed for two operators—conning officer and conning assistant. Each officer was instructed to simulate three maneuvers; man-overboard, replenishment at sea, and maneuvering in restricted waters. He criticized the adequacy of the mock-up in light of the criteria established by the human engineering team by pointing out omissions, overinclusions, faulty layout, and desired substitutions. Two members of the team observed and took notes. The enlisted personnel were also questioned as to their evaluative comments at the conning assistant's position. Comments of both officers and enlisted men were analyzed and a list of recommendations was made. The subjects approved the ship control console concept and were in favor of its automatic features as long as a human override was available. Seating the conning officer and assigning both helm and throttle to the conning assistant alone were disapproved. The results of this experiment, combined with continuing system development efforts, will be used as a basis for refining the conning console design. A prototype operational configuration will be constructed and tested in a simulated environment. Author

N66-32567# Naval Personnel Research Activity, San Diego, Calif.
PITCH MEMORY FOR NEAR THRESHOLD STIMULUS DIFFERENCES
E. G. Aiken and A. W. Lau Apr. 1966 18 p refs
(STB-66-28; AD-482390)

An investigation of memory for the pitch of a short duration pure tone pulse was conducted. Utilizing an 800 cps standard stimulus with comparison stimulus separations of 0, ±3, ±4, ±5 cps, discriminability and constant error measures were taken with .95, 4.5, and 8.9 sec interstimulus separations. The data justify the following conclusions: (1) Pitch discrimination shows no reliable change over the interval from .95 to 8.9 sec. (2) The nature of the incorrect responses indicates an increasing willingness to report a pitch difference as the interstimulus interval increases. (3) A bias in reporting more lower than higher pitch differences at the .95 sec interval reverses at 4.5 sec, and is absent at 8.9 sec. (4) The data are consistent with much previous research involving pure tone discrimination, and with most of the data on Doppler discrimination employing sonar stimulus materials. Author

N66-32572# Gt. Brit. Ministry of Aviation, London.
INVESTIGATIONS ON THE STRESS IMPOSED ON AIRCREW IN CIVIL JET AIRCRAFT DURING LONG-RANGE FLIGHTS, REPORT OF THE NORTH ATLANTIC ROUTE [UNTERSUCHUNGEN ZUR BELASTUNG DES BORDPERSONALS AUF FERNFLUEGEN MIT DUSENMASCHINEN BERICHT UBER DIE ERGEBNISSE AUF DER NORDATLANTIKROUTE]
H. Bruner, K. E. Klein, and S. Ruff Jul. 1966 57 p refs Transl. into ENGLISH from German Rept. DLR-FB(65-44), Oct. 1965 68 p
(TIL-T-5648) CFSTI: HC $2.50/MF $0.50

Results of an investigation on the stress level affecting aircrews on long distance jet aircraft flights are reported. A total of 75 crew members were studied on 25 regular line flights. The mean stress and recovery during the various periods of flight were measured by means of the deviations of the psychophysiological parameters from the daily normal values of a control group who were performing stationary office and laboratory duties. Results form a basis for evaluating the physiological work load on the investigated flight routes, and yield data on the influence of strenuous flights during certain day/night hours upon flight safety. S.P.

N66-32574# Joint Publications Research Service, Washington, D. C.
SECOND ALL-UNION CONFERENCE ON BIONICS
G. T. Kazmin 25 Jul. 1966 12 p Transl. into ENGLISH from Avtomat. i Telemekh. (Moscow), no. 5 1966 p 204-206 Conf. held in Moscow, 20-24 Dec. 1965
(JPRS-36667; TT-66-33098) CFSTI: $1.00

General problems in the field of bionics are briefly reviewed in relation to the necessity for developing cooperative efforts between the various specialist fields such as engineers, biologists, physicists, mathematicians, and chemists. Areas in which research is concentrated are highlighted, and summarized data are presented on several conference reports including the informational, material, and energetic aspects of bionics; technical solutions and equipment; and construction of models and electronic devices. H.S.W.

N66-32619*# General Electric Co., Philadelphia, Pa. Missile and Space Div.
HYDRO-JOHN ENGINEERING PROTOTYPE, THE DESIGN, DEVELOPMENT AND FABRICATION OF A WASTE MANAGEMENT AND WATER RECOVERY SYSTEM
R. W. Murray, F. Rudek, L. Cooper, and R. Miller Oct. 1964 92 p
(Contract NAS9-1301)
(NASA-CR-65436) CFSTI: HC $2.50/MF $0.75 CSCL 06I

A Hydro-John engineering prototype was developed that provides for collection and storage of human excrement and the recovery of potable water under normal conditions but can be extended to function in ecological space systems under zero gravity conditions. Laboratory tests on fecal transport methods, an operational breadboard, disinfectants, water potability, ammonia control and bacterial control, and flush water contamination formed the basis for this self cleansing prototype system. This described semi-automatic system utilizes special container configurations to provide liquid positioning in zero gravity conditions. G.G.

N66-32630*# Beckman Instruments, Inc., Fullerton, Calif. Advanced Technology Operations.
DESIGN, DEVELOPMENT, FABRICATION, TESTING AND DELIVERY OF FIVE (5) CARDIOVASCULAR REFLEX CONDITIONING SYSTEMS Final Report
14 March 1966 44 p
(Contract NAS9-5331)
(NASA-CR-65435; FR-2408-101) CFSTI: HC $2.00/MF $0.50 CSCL 06B

Details are presented on a cardiovascular reflex conditioning system for minimizing the effects of prolonged weightlessness upon astronauts. This system which provides for periodic inflation of pneumatic cuffs around the proximal attachment of the lower extremities, is generally described and the different equipment required for the Apollo and Gemini programs are delineated. The operating principles are given for the input, output, cycling time, pneumatic circuit and control, single-stage regulator and relief valve, and pneumatic oscillator, and preliminary test results on a prototype oscillator assembly are evaluated. Qualification test failures are summarized and the corrective action taken is discussed. The results of acceptance testing, in which the system met all the basic performance requirements, are also included. A.G.O.

06 CHEMISTRY

Includes chemical analysis and identification (e.g., spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 27 Propellants.

N66-31703*# Florida Univ., Gainesville. Quantum Theory Project.

THEORY OF INTERNAL RELAXATION IN CHEMICAL KINETICS

G. Ludwig Hofacker 15 Jan. 1966 50 p refs *Its* Preprint No. 56

(Grant NsG-512)

(NASA-CR-76432) CFSTI: HC $2.00/MF $0.50 CSCL 07D

For molecular systems with a relatively small number of degrees of freedom internal relaxation processes are described by a non-homogeneous master equation for non-diagonal elements of the density matrix. The theory is applied to internal vibrational relaxation and intramolecular rearrangement (isomerization) reactions. The general character and certain types of solutions of the master equation are investigated. Author

N66-31715# Commissariat a l'Energie Atomique, Saclay (France).

CONTRIBUTION TO THE STUDY OF THE SZILARD-CHALMERS EFFECT IN POTASSIUM FERROCYANIDE [CONTRIBUTION A L'ETUDE DE L'EFFET SZILARD-CHALMERS DANS LE FERROCYANURE DE POTASSIUM]

Brigitte Meriadec Jan. 1966 32 p refs In FRENCH

(CEA-R-2873)

During studies on the Szilard-Chalmers effect in potassium ferrocyanide, a chemical separation method was developed for the different ions formed by recoil: Fe^{2+}, Fe^{3+}, and the complex forms of iron. A measurement method was developed also for analyzing separately the isotopes ^{59}Fe and ^{59}Fe and determining the relative amounts of these two isotopes in different chemical states. The experimental results show that the activity of the two isotopes is distributed differently between the complex forms of iron, the ferrous ions, and the ferric ions. This difference is of the order of 40% in the ferrous solution and of 2 to 5% in the ferric retention and ferric solution. Author (NSA)

N66-31739# Iowa State Univ. of Science and Technology, Ames. Ames Lab.

NUCLEATION AND CRYSTAL GROWTH FROM CERAMIC MELTS Selected Bibliography, 1947-1964

J. E. Burlingame and M. F. Berard Sep. 1965 85 p refs

(Contract W-7405-ENG-82)

(IS-1287) CFSTI: HC $3.00/MF $0.75

This bibliography contains 128 references to literature pertaining to the nucleation and growth of crystalline ceramic materials from a melt. An abstract of each publication is provided, and a key word index is included. H.S.W.

N66-31759# Aerojet-General Nucleonics, San Ramon, Calif.

ALKALI METALS EVALUATION PROGRAM Quarterly Progress Report, 1 Oct.-31 Dec. 1965

P. Y. Achener and E. D. Parr [1966] 33 p refs

(Contract AT(04-3)-368)

(AGN-8177) CFSTI: HC $2.00/MF $0.50

Thermodynamic and transport properties for Cs, Rb, and K necessary for the design of space power systems using these metals as working fluids are reported. Certain thermophysical properties of alkali metals that are potential candidates as working fluids in heat pipe (capillary pump) applications are also being considered. Developments in equipment for measuring properties such as: latent heat of vaporization, vapor pressure, surface tension of the liquid in equilibrium with the vapor phase, contact angle between the liquid and the container material, liquid and vapor density, liquid and vapor viscosity, and liquid thermal conductivity for Li, Na, K, Rb, and Cs are described. NSA

N66-31787# Iowa State Univ. of Science and Technology, Ames. Ames Lab.

LANTHANUM-LANTHANUM HYDRIDE PHASE SYSTEM

John Alphonse Straatmann (M.S. Thesis) Feb. 1966 36 p refs

(Contract W-7405-ENG-82)

(IS-T-79) CFSTI: HC $2.00/MF $0.50

The phase relations between La and LaH_2 were determined. The melting point of La increased with the addition of H_2. The addition of H_2 also decreased the fcc to bcc transformation temperature of La to a eutectoid at 773°C and 23.5 at.% H_2. The solubility of LaH_2 in fcc La ranged from 2.83 at.% at 375°C to 21.3 at.% H_2 at 773°C. The enthalpy of solution was calculated to be 5.76±0.17 kcal. Above 773°C the solubility of LaH_2 in bcc La increases rapidly and complete solubility occurs at temperatures above 960°C. LaH_2 has no appreciable effect on the low temperature transformation from hcp to fcc La. Author (NSA)

N66-31788# Stanford Research Inst., Menlo Park, Calif.

SORPTION OF GASES ON METAL SURFACES IN ULTRA-HIGH VACUUM Annual Report, Feb. 15, 1965-Feb. 14, 1966

B. Bergsnov-Hansen, N. Endow, B. Evans, and R. A. Pasternak 23 Mar. 1966 78 p refs

(Contract AT(04-3)-425)

(SRIA-425-8) CFSTI: HC $3.00/MF $0.75

Systematic investigation of the adsorption mechanisms of different gases on Mo films was continued. The study of nitrogen adsorption was completed. The adsorption kinetics of inert gases Xe and Kr on Mo films and Pyrex glass suggest that the adsorbate has high surface mobility. The isotherms indicate that the interaction forces between an inert gas and a surface depend only little on the physical and chemical characteristics of the adsorbent. In deuterium adsorption on Mo, the saturation amounts increased with decreasing temperature, by a factor of about 1.5 from 25 to -196°C, and increased slightly with pressure. The rate law for adsorption was also found to change with temperature. Both the saturation

coverages and the kinetics can be explained by a coverage dependent heat of adsorption of deuterium. Final results are given for hydrogen–deuterium exchange reaction at steady state. In the investigation of interaction of N and O with Nb ribbons at room temperature, only adsorption occurred, diffusion into the bulk being slow, and the kinetics were similar to that observed for Mo. In an intermediate range, a complex mechanism, probably involving both formation of surface layers and diffusion was found. Detailed quantitative mechanisms for the sorption processes were formulated. NSA

N66-31831# United Kingdom Atomic Energy Authority, Windscale (England). Production Group.

ANALYTICAL METHOD FOR THE DETERMINATION OF IRON IN HIGH PURITY PLUTONIUM

G. A. Bell, P. R. Stanwix, and D. G. Boase 1966 18 p refs (PG-709(W)) HMSO: 2s 6d

A sensitive method is described for the determination of iron in plutonium metal. The procedure utilizes the formation of the iron(II)–tris-bathophenanthroline complex in the presence of EDTA which suppresses the interference and hydrolysis of plutonium. Solvent extraction of the colored iron complex into chloroform adds specificity to the method, and subsequent absorptiometric measurement allows the determination of iron down to levels of 1–2 ppm in plutonium metal. A precision of ±10% can be achieved at the 10 ppm level. Author

N66-31841# Reactor Group, United Kingdom Atomic Energy Authority, Culcheth (England).

DETERMINATION OF THE SPECIFIC ACTIVITY OF ^{14}C LABELLED CARBON: A CRITIQUE

M. F. Sheppard 1966 16 p refs (TRG-1059(C)) CFSTI: HC $1.00/MF $0.50

Existing procedures for the determination of specific activity are reviewed in the light of current ideas on mechanisms of graphite attack. Some experimental evidence is now becoming available to show that theoretical defects in the procedures can in fact lead to incorrect answers. The importance of thorough checks on the homogeneity of labelling of samples is emphasized, and the immediate program of experimental work is outlined. Author

N66-31860*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

CHEMICAL REACTIONS OF CARBIDES, NITRIDES, AND DIBORIDES OF TITANIUM AND ZIRCONIUM AND CHEMICAL BONDING IN THESE COMPOUNDS

Warren H. Philipp Washington, NASA, Aug. 1966 22 p refs (NASA-TN-D-3533) CFSTI: HC $1.00/MF $0.50 CSCL 07B

Because the group IVA transition metal carbides, nitrides, and borides may possibly be used as high-temperature materials, their physical properties have been given considerable investigation. The reactions of these refractories under study were investigated in various media, including chromic acid solution, hydrochloric acid, acidified hydrogen peroxide, fused potassium hydroxide, and solutions containing hydrofluoric acid. Semiquantitative analyses of the reaction products are presented, including mass-spectrometric determinations of evolved gases. Based on a comparison of the chemical properties of the group IVA carbides, nitrides, and borides with those of known bonding, the nature of the bonding is discussed. The hypothesis used assumes that the outer electrons of the nonmetal (carbon, nitrogen, boron) interact with the d orbitals of the transition metal atom. Author

N66-31890*# Stanford Univ., Calif. School of Medicine.

CALCULATION OF MOLECULAR FORMULAS IN HIGH-RESOLUTION MASS SPECTROMETRY

Joshua Lederberg [1964] 24 p refs Append. to "Structure Elucidation of Natural Products by Mass Spectrometry. Volume II: Steroids, Terpenoids, Sugars, and Miscellaneous Classes" San Francisco, Holden-Day, Inc. 1964 p 279–297 (Grant NsG-81-60) (NASA-CR-76467) CFSTI: HC $1.00/MF $0.50 CSCL 07C

In connection with high-resolution measurement of molecular mass, the decimal weights of hydrogen, oxygen, and nitrogen organic molecule combinations are listed in tabular form. To assist chemists in their arithmetical tasks, the step-by-step method of calculation is described. A basic block of tabulations covers the ranges of oxygen up to 11, nitrogen up to 7, and any value of carbon. To encompass larger values of hydrogen in a compressed version of the tables, the calculation method includes a step of figuratively extracting some multiple of 12H from the molecules, as necessary. R.Ll.

N66-31912# Chemical Lab. RVO-TNO, Rijswijk (Netherlands).

SEPARATION OF IMIDAZOLE AND ITS N-METHYL DERIVATIVES ON POLYAMIDE THIN LAYERS

A. Verweij Apr. 1966 9 p refs *Its* Rept.-1966-8 (TDCK-45525) CFSTI: HC $1.00/MF $0.50

Imidazole (I), N-methyl imidazole (II) and N,N'-dimethyl imidazolium iodide (III) could be separated efficiently by means of thin-layer chromatography on polyamide, using methyl ethyl ketone as a solvent. This separation is based on differences in the attractive forces between the compounds mentioned and polyamide. Compound I has the property to form a hydrogen bond between its –NH– group and amide groupings. Compound III, being of an ionic character consequently has an even stronger affinity to polyamide. Compound II, having neither a –NH– group nor an ionic group will show less affinity to polyamide than either I or III. The resulting R_f-sequence is III < I < II. Author

N66-31913# Chemical Lab. RVO-TNO, Rijswijk (Netherlands).

SYNTHESES AND TOXICITIES OF SOME SERIES OF CHOLINESTERASE INHIBITION AGENTS. XIII: THE PREPARATION OF DIALKYL PHOSPHOROFLUORIDATES USING PICRYL FLUORIDE OF 2,4-DINITROFLUORBENZENE

H. L. Boter May 1966 12 p refs *Its* Rept.-1966-9 (TDCK-45558) CFSTI: HC $1.00/MF $0.50

Dimethyl, diethyl and diisopropyl phosphorofluoridate were synthesized in yields varying from 71–88% and with excellent purities (96–99%) by treatment of the dicyclonaxylamine salts of the corresponding O,O-dialkyl hydrogen phosphorothioates with picryl fluoride in methyl acetate solution, performing the syntheses at room temperature. A comparable yield of pure diisopropyl phosphorofluoridate was obtained when the dicyclohexylamine salt of O,O-diisopropyl hydrogen phosphorothioate was replaced by that of diisopropyl hydrogen phosphate, using identical reaction conditions. Both salts did not react at all with 2,4-dinitrofluorobenzene at room temperature. Prolonged heating in methyl acetate solution however gave a high yield of diisopropyl phosphorofluoridate when the first salt was used. Only minor yields were obtained when using the dicyclohexylamine salt of diisopropyl hydrogen phosphate under these more drastic conditions. The acid, O,O-diisopropyl hydrogen phosphorothioate and its S-ethyl ester failed to react with picryl fluoride, even at elevated temperature. Author

N66-31920# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.

STUDY OF THE POSSIBILITY OF A COUPLING OF THE SULPHURIC ACID AND NITROGEN-15 PRODUCTION [STUDIUM NAD MOZLIWOSCIA SPRZEGNIECIA PRODUKCJI KWASU SIARKOWEGO METODA NITROZOWA Z PRODUKCJA AZOTU-15]

Anatol Selecki and Jan Bulanda 1965 25 p refs In POLISH (Rept.-674/XVI/J) CFSTI: HC $1.00/MF $0.50

The technical feasibility and economic factors of combining two methods for the production of highly concentrated nitrogen 15 is discussed. Considered are the Nitrox method and the tower process for the conversion of sulfuric acid. Detailed analysis of the two methods indicates that the combination is possible and that a lowering of production costs will be achieved. Transl. by K.W.

N66-31928*# Union Carbide Corp., Bound Brook, N. J. Polymer Research and Development Dept.

SATURATED HYDROCARBON POLYMERIC BINDER FOR ADVANCED SOLID PROPELLANT AND HYBRID SOLID GRAINS Quarterly Report No. 2, 1 Feb.-30 Apr. 1966

James E. Potts, ed., A. C. Ashcraft, Jr., E. M. Sullivan, and E. W. Wise [1966] 23 p Prepared for JPL (Contracts NAS7-100; JPL-951210)

(NASA-CR-76476) CFSTI: HC $1.00/MF $0.50 CSCL 20I

Ethylene-neohexene prepolymers were prepared using the organic peroxides succinic acid peroxide and glutaric acid peroxide. These initiators result in acid terminated prepolymers which are quite high in viscosity considering their molecular weights. Esterification of the acid end groups results in a drastic decrease in viscosity, which is attributed to elimination of hydrogen bonding association. Functionalities approaching two carboxyl groups per molecular have been obtained based on molecular weight determinations in benzene. Molecular weight determinations in polar solvents such as tetrahydrofuran yield functionalities closer to one. Diethyl α,α'-azobisisobutyrate has been prepared and its kinetics of thermal decomposition measured at 100°C. This initiator has been used to make three copolymerizations which proceeded very smoothly. The products are being hydrolyzed and characterized. Author

N66-31994# United Kingdom Atomic Energy Authority, Capenhurst (England). Production Group.

MANUAL OF ANALYTICAL METHODS FOR GRAPHITE AND ASSOCIATED CARBONACEOUS MATERIALS

1966 128 p Revised

(PG-177(CA), Rev.) HMSO: £2

This laboratory handbook delineates methods and experimental procedures for analytical determinations of graphite and associated carbonaceous materials. Although the methods discussed were developed primarily for nuclear grade graphite and associated raw materials, it is stated that the methods may be applied to other carbon products. A step-by-step outline of the procedures for each determination is provided and the special apparatus required is identified. H.S.W.

N66-32004# National Bureau of Standards, Washington, D. C.

METHODS FOR THE CHEMICAL ANALYSIS OF NBS COPPER-BASE SPECTROCHEMICAL STANDARDS Standard Reference Materials

Rosemond K. Bell 25 Oct. 1965 105 p refs

(NBS-Misc. Publ.-260-7) GPO: $0.60

The methods for chemical analysis described in this publication are those used for the determination of the various constituents of 21 copper-base spectrochemical standards. The methods cover procedures for the analysis of seven principal standard alloys known as cartridge brass, free-cutting brass, naval brass, red brass, gilding metal, commercial bronze, and aluminum brass of nominal, high, and low composition. The methods are selected or designed primarily for accuracy rather than for speed. Author

N66-32085# Pennsalt Chemicals Corp., King of Prussia, Pa. Research and Development Dept.

TITANIUM(IV) CHELATES CONTAINING BINEGATIVE LIGANDS

G. H. Dahl and B. P. Block May 1966 11 p refs

(Contract Nonr-2687(00))

(TR-50; AD-632720) CFSTI: HC $1.00/MF $0.50

The reaction of titanium(IV) alkoxides in 1:1 stoichiometry with 2-methyl-2,4-pentanediol, pyrocatechol, salicylic acid, or P,P'-diphenylmethylenediphosphinic acid yields chelates of the form $Ti(BB)(OR)_2$, where BB represents the binegative bidentate ligands involved and R ethyl or isopropyl. A similar reaction with 1,3-propanediol does not produce $Ti(OC_3H_6O)(OR)_2$ but instead $Ti(OC_3H_6O)_2$ and $Ti(OR)_4$ are recovered. The $Ti(BB)(OR)_2$ derivatives are all associated in solution. Replacement of the alkoxy groups with acetylacetonate groups in the pyrocatecholate derivative gives the monomeric mixed chelate techolate derivative gives the monomeric mixed chelate

$$[Ti(o\text{-}C_6H_4O_2)(C_5H_7O_2)_2].$$

P,P'-Diphenylmethylenediphosphinic acid was prepared via the reaction of diisopropyl phenylphosphonite with methylene iodide. Author (TAB)

N66-32092# Little (Arthur D.), Inc., Cambridge, Mass.

THE STRUCTURAL FORMS OF LIQUID WATER AT INTERFACES AND NEAR BIOPOLYMERS

R. A. Horne 31 May 1966 10 p refs

(Contract Nonr-4424(00))

(TR-22; AD-632723) CFSTI: HC $1.00/MF $0.50

Liquid water consists of free water and two structural forms. The first of these forms constitutes the Frank-Wen clusters and the hydration atmospheres of ions whereas the second form, which is much more stable with respect to hydrostatic pressure, is present in small amounts in the bulk water but is the principle form at interfaces and near hydrophobic molecules or parts of molecules. Author (TAB)

N66-32099# California Univ., La Jolla. Dept. of Chemistry.

CARBONIUM ION RADICALS AND OXY RADICALS Status Report, 1 Aug. 1964-Apr. 1965

Teddy G. Traylor 20 Apr. 1966 8 p refs

(Grant AF-AFOSR-514-64)

(AFOSR-66-0763; AD-632825) CFSTI: HC $1.00/MF $0.50

The study concerns the comparison of ferrocenylmethyl derivatives (chlorides mostly) with benzyl derivatives with respect to unimolecular and bimolecular nucleophilic substitution. A quantitative comparison is found which allows the conclusion that the extreme reactivity of the former systems derives from the cyclopentadienide structure and not from the iron. Resonance stabilization by the cyclopentadienide

moiety accounts for the reactivity and an elimination process accounts for the fact that the leaving anion and the iron assume a trans arrangement in the ionization of ferrocenylmethyl chloride or other derivatives. In addition, a study of the effect of viscosity on the chain length of radical induced decomposition of hydroperoxides has shown that the chain carrying process is diffusion of alkoxyl radicals (RO·) from a solvent cage containing (2RO·) and the chain termination is merely collapse of these radicals to ROOR within the cage. Author

N66-32150# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CHEMICAL DOSIMETRY OF IONIZING RADIATIONS

A. M. Kabakchi, Ya. I. Lavrentovich, and V. V. Pen'kovskiy 15 Mar. 1966 168 p refs Transl. into ENGLISH from the book "Khimicheskaya Dozimetriya Ioniziruyushchikh Izluchenii" Kiev, Izd. Akad Nauk Ukr. SSR, 1963 p 1-76, 86-92, 105-135

(FTD-TT-65-420; AD-633348) CFSTI: HC $5.00/MF $1.00

This volume generalizes the theoretical and experimental material that has been accumulated during recent years in the field of chemical dosimetry. Attention is focused on the justification for the use of chemical-dosimetry methods to solve problems that are difficult or impossible to solve by other methods (measurement of absorbed dose in joules per kilogram, separate determination of the doses of several types of radiation acting simultaneously on the medium, measurement of large doses, and the like). The book sets forth in detail the technique of determining size of dose by chemical methods in the solution of various practical problems. Author (TAB)

N66-32153# Virginia Univ., Charlottesville. Dept. of Chemistry.

STUDIES OF METHYL DERIVATIVES OF 1,2-DICARBACLOVOPENTABORANE(5)

Russell N. Grimes 3 May 1966 14 p refs Submitted for Publication

(Contract Nonr-474(13))

(TR-1; AD-632793) CFSTI: HC $1.00/MF $0.50

The thermal stability of C,3-dimethyl-1,2-dicarba clovopentaborane (5) was examined in the liquid and vapor states. Pyrolysis of the liquid at 130° C yielded a trimethyl and two tetramethyl derivatives of 1,2-$C_2B_3H_5$,plus trimethyl boron and nonvolatile solids. The vapor diluted in helium was unreactive at 115° C but at 230° C partially reacted to give C,5-$(CH_3)_2$-1,1-$C_2B_3H_3$ and C,3,5-$(CH_3)_3$-1,2-$C_2B_3H_2$. No rearrangement of the 1,2- carborane cage structure was observed, and the higher methylated derivatives were more stable than C,3-$(CH_3)_2$-1,2-$C_2B_3H_3$. C,3-$(CH_3)_2$-1,2-$C_2B_3H_3$ reacted with 2,4,6-collidine to produce a red complex. The significance of the stability of the methylated 1,2-$C_2B_3H_5$ structure is discussed in relation to other experimental and theoretical studies of the carboranes. Author (TAB)

N66-32180# Grumman Aircraft Engineering Corp., Bethpage, N.Y. Advanced Development Program.

CARBON DIOXIDE REMOVAL BY IONIZATION

Arnold Reed Aug. 1965 30 p refs

(ADR-04-06-65.1)

An attempt was made to capitalize on the disparity of ionization characteristics of carbon dioxide and oxygen to effect a means of separating the two gases from a mixture. Twelve millicuries of the radioisotope Americium 241, supplied the ionization energy. The CO_2 ions were expected to be positive only; the oxygen ions were expected to range from 50% positive and 50% negative to 100% negative. An electrostatic voltage was applied to separate the positive from negative ions. No separation was detectable with an infrared analyzer. If this method is feasible, the amount of radioactivity would have to be greatly increased. Eighteen thousand curies would theoretically have been required to ionize every molecule passing through the apparatus with a single charge. Author

N66-32252*# Southern Research Inst., Birmingham, Ala.

A STUDY OF POLYMERS CONTAINING SILICON-NITROGEN BONDS Annual Summary Report, May 4, 1965-May 3, 1966

Robert E. Burks, Jr., Edward R. Covington, and Thomas W. Ray [1966] 160 p refs *Its* Rept.-12

(Contract NAS8-20190)

(NASA-CR-76654) CFSTI: HC $3.25/MF $1.00 CSCL 07C

The chemistry of silicon-nitrogen compounds has been studied to find routes to polymers that will be useful in aerospace technology. Two types of silphenylene polymers appear to be promising as sources of elastomers with good stability to heat and radiation. Coatings for titanium that were stable for more than 100 hours at 540°C (1000°F) were made from a silphenylene amine polymer and a methylphenyl silazane pigmented with aluminum. Silylamines also are effective curing agents for epoxy resins to produce polymers with good thermal stability, and they cure organic diisocyanates to resins, probably by a cyclization mechanism. Isocyanate polymers have been made with attractive physical properties at ordinary temperatures, but the combinations tried so far do not look promising for either high- or low-temperature applications. Author

N66-32305*# Westinghouse Electric Corp., Pittsburgh, Pa. Research Labs.

SILICON OXIDE FILMS GROWN AND DEPOSITED IN A MICROWAVE DISCHARGE

J. Kraitchman and R. M. Handy [1966] 65 p refs

(Contract NAS8-11931)

(NASA-CR-76658) CFSTI: HC $2.50/MF $0.75 CSCL 07D

The growth and deposition of silicon dioxide in a microwave discharge was investigated, and it was determined that this technique provides a process for rapidly oxidizing silicon at temperatures estimated to be 500°C or lower. It is reported that the growth rate can be enhanced both by the application of a dc potential to the sample and by external means, which modify the plasma distribution and configuration. The apparatus used and the experimental techniques employed are discussed, and the characteristics of devices made using this process were compared to devices made using thermally grown oxides. Etch rate, infrared spectra, breakdown strength, and resistivity measurements indicate that the oxides produced by this process have properties which are indistinguishable from those of thermally grown oxides. H.S.W.

N66-32310# New York Univ., N.Y. Dept. of Chemistry.

DOUBLE LAYER IMPEDANCE OF ELECTRODES WITH CHARGE TRANSFER REACTION

Paul Delahay and Gilles G. Susbielles Apr. 1966 26 p refs Submitted for Publication

(Contract Nonr-285(65))

(TR-1; AD-632896) CFSTI: HC $2.00/MF $0.50

Equations for the electrode impedance are derived for metal-ion amalgam electrodes and other electrode reactions

without a priori separation of Faradaic and double layer charging processes. Experimental conditions for electrode impedance measurements are re-examined with some emphasis on Sluyters's method for separation of the double layer capacity. Results are derived for metal–ion amalgam electrodes, and other types of electrode reactions are discussed. (TAB)

N66-32323# India. Dept. of Atomic Energy, Bombay.
PROCEEDINGS OF THE NUCLEAR AND RADIATION CHEMISTRY SYMPOSIUM 1966
18 Apr. 1966 382 p refs Symp. held at Waltair, India, 20–22 Jan. 1966
CFSTI: HC $4.25/MF $2.00

Papers from a symposium on nuclear and radiation chemistry are presented. The papers cover various aspects of the subject such as separation and estimation, complex formation, spectroscopy, radiolysis, labelling, and biological materials. Transcripts of the discussion periods following several reports are also included. A.O.

N66-32359# Iowa State Univ. of Science and Technology, Ames.
DETERMINATION OF LIQUID METAL DIFFUSION COEFFICIENTS BY MOLECULAR DISTILLATION
C. H. Buell and F. O. Shuck Feb. 1966 33 p refs
(Contract W-7405-ENG-82)
(IS-1325) CFSTI: HC $2.00/MF $0.50

A study was made on the feasibility of measuring liquid metal diffusion coefficients during molecular distillation. Although no other data for the zinc–indium system are available, a comparison with similar systems at this temperature (450°C) indicated that the value measured (1.69×10^{-4} cm^2/sec) is high by a factor of two to five. The major error in the measurements appears to be caused by the fact that the non-volatile indium is more dense than the volatile zinc. Author (NSA)

N66-32360# Iowa State Univ. of Science and Technology, Ames.
APPARENT MOLAL VOLUMES AND VISCOSITIES OF SOME AQUEOUS RARE-EARTH CHLORIDE SOLUTIONS AT 25°C
Michael Jon Pikal and F. H. Spedding Feb. 1966 172 p refs
(Contract W-7405-ENG-82)
(IS-1344) CFSTI: HC $5.00/MF $1.00

The specific gravities and apparent molal volumes of aqueous solutions of $PrCl_3$, $SmCl_3$, $GdCl_3$, $TbCl_3$, $DyCl_3$, $HoCl_3$, and $ErCl_3$ were determined over a concentration range of about 0.0015 to 0.18 molar. A magnetically controlled float apparatus was used to determine the specific gravities. The concentration dependence of the apparent molal volumes of these salts showed significant deviations from the simple limiting law at low concentrations. However, it was found that, except for $Nd(NO_3)_3$, these deviations are consistent with interionic attraction theory if the effect of the distance of closest approach parameter, a, is recognized. The partial molal volumes at infinite dilution, $\bar{V}_2^0$, decrease smoothly with decreasing ionic radius from La to Nd and from Tb to Yb, but from Nd to Tb the $\bar{V}_2^0$ values increase with decreasing ionic radius. This irregular behavior is discussed in terms of a gradual change in preferred water coordination number of the rare-earth ion occurring over the rare-earth ions from Nd^{3+} to Tb^{3+}. The relative viscosities of aqueous solutions of $LaCl_3$, $NdCl_3$, $SmCl_3$, $TbCl_3$, $DyCl_3$, $HoCl_3$, and $ErCl_3$ were determined at 25°C over a concentration range of about 0.05 molal to saturation at 25°C. The B coefficients of the Jones–Dole equation were also determined for these salts. The relative viscosities of several dilute $PrCl_3$ solutions were also measured to allow the B coefficient for this salt to be determined. The concentration dependence of the relative viscosity of a rare-earth chloride solution is discussed in terms of the Vand theory for large non-electrolyte molecules. The B coefficients and the relative viscosities at iso-molalities were studied as a function of the ionic radius of the rare-earth ion, and irregularities were noted near the middle of the rare-earth series. NSA

N66-32361# Los Alamos Scientific Lab., N. Mex.
SEPARATION AND SPECTROPHOTOMETRIC MEASUREMENT OF 0.5 TO 10 PARTS PER MILLION OF THORIUM IN PLUTONIUM
R. G. Bryan and G. R. Waterbury 25 Apr. 1966 19 p refs
(Contract W-7405-ENG-36)
(LA-3468) CFSTI: HC $2.00/MF $0.50

Trace concentrations (0.5 to 10 ppM) of thorium in plutonium were measured spectrophotometrically as the Arsenazo III complex, following separation by a two-step precipitation-anion exchange resin method. In the first separation step, plutonium is oxidized to the (VI) oxidation state in fuming perchloric acid, and the thorium, with lanthanum carrier, is precipitated as the fluoride while the plutonium (VI) remains in solution. In the second step, the precipitate is dissolved in 7.8 $\bar{N}$ nitric acid and passed through an anion exchange resin column which adsorbs only the thorium and remaining traces of plutonium. The thorium is eluted selectively with 12 $\bar{N}$ hydrochloric acid, and the thorium–Arsenazo III complex is formed in 4 $\bar{N}$ perchloric acid. At a wavelength of 665 $m\mu$, the molar absorptivity of the complex is 113,000. Relative standard deviations calculated from 12 or more determinations each of 0.5, 2, 3, 5, and 10 μg of thorium added to 1-gram samples of plutonium are 4.7, 3.7, 3.9, 2.3, and 2.2%, respectively. Of 45 other elements investigated, only Al, Sb, Ca, La, Mo, Sn, and W cause interference when present in 100-mg quantities. Of these interfering elements, only antimony interferes when the quantity is reduced to 10 mg. Author (NSA)

N66-32364# Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science.
CHEMISTRY PROGRESS REPORT, NOVEMBER 1, 1964–DECEMBER 31, 1965
31 Dec. 1965 101 p
(Contract AT(30-1)-905)
(MIT-905-52)

Progress in nuclear chemistry, instrumental chemistry, and organic isotope application studies is reported. The nuclear chemistry area consists of investigations in such areas as decay schemes of the ^{117}Cd isomers; short lived excited states in ^{117}In; decay schemes of ^{115}Cd isomers; nuclear fission; nuclear reactions; and instrumentation and data handling. The instrumental chemistry area consists of work on over twenty separate problems. A number of them can be grouped together under the general heading of electroanalytical chemistry, and range from fundamental studies of single crystal electrodes to the development of analytical methods for trace elements in the environment. Another group of the problems falls in the area of luminescence, and the remainder include such diverse subjects as plasma

spectroscopy, vapor liquid equilibrium, and computer methods for interpreting complex ion spectra. The isotope applications studies include the reaction mechanisms of triphenylmethyl chloride in benzene; the ionizing power of tetra-n-hexylammonium benzoate; enolization of ketones by bases; decomposition mechanism of benzenediazonium ions; and the selectivity in free radical reactions. C.T.C.

N66-32390# Bureau of Mines, Berkeley, Calif.
HEATS AND FREE ENERGIES OF FORMATION OF ANHYDROUS CARBONATES OF BARIUM, STRONTIUM, AND LEAD
L. H. Adami and K. C. Conway 1966 12 p refs
(BM-RI-6822)

The heats of formation of anhydrous barium carbonate (witherite), strontium carbonate (strontianite), and lead carbonate (cerussite) were determined by solution calorimetry. The solution mediums were hydrochloric acid for barium and strontium carbonates and perchloric acid for lead carbonate. The heats of formation at 298.15°K are as follows: $BaCO_3$ −297.5±0.8 kcal/mole; $SrCO_3$ −294.6±0.5 kcal/mole; and $PbCO_3$ −168.0±0.3 kcal/mole. Author

N66-32404# Consolidation Coal Co., Library, Pa.
BETA RADIATION-INDUCED TELOMERIZATION OF METHANOL WITH ETHYLENE Final Report, 1 Nov. 1964–30 Apr. 1965
P. M. Yavorsky, N. J. Mazzocco, and E. Gorin Oak Ridge, Tenn., AEC, 10 Sept. 1965 53 p refs
(Contract AT(30-1)-2978)
(NYO-2978-44) CFSTI: HC $3.00/MF $0.50

Using a strontium-90 beta irradiator in a continuous vapor phase processing unit at elevated temperatures and pressures, a study of controllable variables was made to optimize production of $+C_{11}$ alcohols from radioinduced telomerization of methanol with ethylene. The long-chain aliphatic alcohols produced by radiation are primarily desired as intermediates for sulfation to biodegradable detergents. Detailed results of 24 variable runs with radiation are reported, for which the dose rate was 1.69×10^6 rad/hr. G-values for the overall radiation-telomerization reaction were as high as 14,700, but for runs with the more favorable, selective yields of $+C_{11}$ alcohols, G-value for the reaction ranged between 5,000 and 10,000. Optimum operating conditions for maximum $+C_{11}$ alcohol yield, within those tested, were 4500 psi, 300°C, 2:1 methanol:ethylene feed ratio, and a 5 minute irradiation or reaction residence time. Good radiation yields also were obtained at 2500 psi, but increasing pressure had many favorable effects. Without radiation there was practically no telomerization yield at these conditions. In addition to alcohols, the radiation products contained ethers, minor amounts of hydrocarbons, some unsaturation (olefins), and had molecular branching when produced at 2500 psi. Branching disappeared for 4500 psi products. Hydrogen migration in radicals involved in the telomerization reaction can explain the array of products. Author (NSA)

N66-32424# Bureau of Mines, Reno, Nev.
EXTRACTION AND SEPARATION OF SELECTED LANTHANIDES WITH TERTIARY AMINE
D. J. Bauer 1966 21 p refs
(BM-RI-6809)

The feasibility of fractionating lanthanide nitrates with a tertiary amine on lanthanum–cerium and thulium–ytterbium pairs was demonstrated. Optimum values were determined for pH, phase concentration, and percent chelation of metal ions in the aqueous phase. Percent extraction is markedly dependent on the concentration of lithium nitrate in the aqueous phase. Selective masking of the heavier element in each extraction system with DTPA or EDTA aqueous-phase chelating agents resulted in lanthanum–cerium separation factors of 8.5 and thulium–ytterbium separation factors of 3.4. Author

N66-32451# North Carolina State Coll., Raleigh. Dept. of Textile Chemistry.
RADIATION-INDUCED OXIDATION OF HYDROCARBONS
Arthur A. Armstrong, Jr. and William K. Walsh 15 Jul. 1965 40 p refs
(Contract AT(40-1)-3210)
(ORO-634) CFSTI: HC $2.00/MF $0.50

The radioinduced oxidation of ethane, propane, and isobutane was studied in a flow-type reactor using hydrogen bromide as a catalyst. In the oxidation of ethane a G-value of 800 was obtained for the production of acetic acid. An increase in total flow rate of ethane to the reactor increased the production rate of acetic acid. The most pronounced effect was noted from an increase in pressure. In the oxidation of propane a G-value of 10,000 was obtained for the production of acetone. Increases in total flow rate did not affect the rate of production. In the oxidation of isobutane the products were t-butyl bromide, methyl bromide, and water. NSA

N66-32453# Oak Ridge National Lab., Tenn.
REACTOR CHEMISTRY DIVISION Annual Progress Report, Period Ending 31 Dec. 1965
Mar. 1966 161 p refs
(Contract W-7405-ENG-26)
(ORNL-3913) CFSTI: HC $5.00/MF $1.00

Progress reports in the field of reactor chemistry are presented including molten-salt, aqueous, and gas-cooled reactors and nuclear safety. Topics considered under molten-salt reactors are phase equilibrium and crystallographic studies, chemical studies of molten salts, chemical separation and irradiation behavior, and direct support. Corrosion and chemical behavior in reactor environments, chemistry of high temperature aqueous solutions, and interaction of water with particulate solids are covered under aqueous reactors. Subjects reviewed under gas-cooled reactors include diffusion processes, reactions of reactor components with oxidizing gases, irradiation behavior of high temperature fuel material, fission-gas release during fissioning of UO_2, and miscellaneous studies for solid-fueled reactors. Nuclear safety tests in major facilities and laboratory supporting studies are reported under nuclear safety, and other programs covered include chemical support for saline water program, effects of radiation on organic materials, fluoride studies, and chemical support for controlled thermonuclear research program. L.E.W.

N66-32455# California Univ., Berkeley. Lawrence Radiation Lab.
NUCLEAR CHEMISTRY DIVISION Annual Report, 1965
J. M. Hollander, F. Reynolds, B. B. Cunningham, ed. Jan. 1966 290 p refs
(Contract W-7405-ENG-48)
(UCRL-16580) CFSTI: HC $6.00/MF $1.50

Summary reports are given in the field of nuclear chemistry, including radioactivity and nuclear structure, fission, nuclear reactions and scattering, radiation chemistry, inorganic

chemistry, instrumentation, and chemical engineering. Thesis abstracts are also presented and an author index is included. Some of the topics covered are nuclear spin and moment of Ag^{110m} by paramagnetic resonance, identification of heavy-ion reaction products by in-beam X-ray measurement, fission properties of some elements below radium, high energy deuteron cross sections, hypersensitive transitions in rare earth ions, reactivity of the hydrated electron with organo-nitrogen compounds, spectrophotometric determination of gold with azide, germanium gamma ray detector development, mica track scanner, and kinetics of bacterial sulfate reduction. L.E.W.

N66-32457# Union Carbide Nuclear Co., Oak Ridge, Tenn. Y-12 Plant.
SPECTROGRAPHIC DETECTION OF TRACE ELEMENTS IN ALUMINUM METAL
O. P. Killeen 5 May 1966 14 p refs
(Contract W-7405-ENG-26)
(Y-1532) CFSTI: HC $1.00/MF $0.50

The preparation of suitable samples and standards was a major problem in the spectrographic determination of impurities in aluminum metal. This was solved by dissolving the aluminum samples in aqua regia and thermally decomposing the resulting salt into aluminum oxide. Ten samples of aluminized Mylar were analyzed, and all were found to be quite impure in the common elements. Data are tabulated. NSA

N66-32477# National Lead Co. of Ohio, Cincinnati. Technical Div.
A RAPID DETERMINATION OF OXYGEN IN HIGH-PURITY MAGNESIUM CHIPS BY NEUTRON ACTIVATION ANALYSIS
B. L. Twitty and K. M. Fritz May 1966 23 p refs
(Contract AT(30-1)-1156)
(NLCO-973) CFSTI: HC $2.00/MF $0.50

A nondestructive method was developed for determining the oxygen content of magnesium chips by 14-Mev activation using a neutron generator. In this method the high-energy gamma rays of 7-second nitrogen-16, formed by the n,p reaction of oxygen-16, are measured. An internal standard is used which eliminates the need for weighing samples or making flux corrections. Hence this technique reduces the total time required for analysis. The internal standard used is the 0.976-Mev gamma ray of sodium-25, formed by the n,p reaction of magnesium-25. Precisions were determined for samples of loose and pelletized chips in air and in nitrogen atmospheres at three different flux levels. Using loose chip samples in a nitrogen atmosphere near a flux of 1×10^8 n/cm^2/sec and an average of 3 aliquots, a precision of analysis of ±0.011% oxygen was obtained at the 95% confidence level (C.L.) in the range of 0.1 to 0.3% oxygen. Under these conditions, 35 samples can be prepared, analyzed, and reported per man-day. Using pelletized samples in a nitrogen atmosphere near a flux of 1×10^9 n/cm^2/sec, a precision of ±0.006% oxygen was obtained at the 95% C.L. using an average of 3 aliquots. Author (NSA)

N66-32480# Oak Ridge National Lab., Tenn.
OXIDATION OF UNFUELED AND FUELED GRAPHITE SPHERES BY STEAM
J. L. Rutherford, J. P. Blakely, and L. G. Overholser May 1966 37 p refs
(Contract W-7405-ENG-26)
(ORNL-3947) CFSTI: HC $2.00/MF $0.50

The oxidation of various unfueled and fueled graphite spheres (1.5-in. and 2.36-in. dia) by steam was studied at 800, 900, and 1,000°C using a partial pressure of ~730 torr and flow rates of 600 to 1,200 cm^3/min (STP) of steam. The fueled spheres contained pyrolytic-carbon coated UC_2 or $(U,Th)C_2$ particles dispersed in graphite matrices; the unfueled spheres were machined from ATJ and Speer Moderator-2 grades of graphite. Reaction rates were determined from weight changes and analyses of the effluent gases. Pronounced effects of burnoff on reaction rates and CO/CO_2 ratios were observed. BET surface area and mercury porosimetry data obtained for several oxidized unfueled spheres are included. Reaction rates measured for the fueled spheres were, in general, comparable to those found for the unfueled spheres. The graphite matrices appear to have afforded considerable protection for the coated fuel particles against attack by steam. Author (NSA)

N66-32483# California Univ., Livermore. Lawrence Radiation Lab.
PREPARATION AND PROPERTIES OF 2,4-DINITROPHENYL FLUORALKYL ETHERS
Eugene R. Bissell and Sheldon A. Schaffer 25 Feb. 1966 8 p refs
(Contract W-7405-ENG-48)
(UCRL-14714) CFSTI: HC $1.00/MF $0.50

2,4-Dinitrophenyl ethers of trifluoroethanol, 2,2,3,3-tetrafluoropropanol, heptafluorobutanol, 1,1,5-trihydroperfluoropentan-1-ol, 1,1,7-trihydroperfluoroheptan-1-ol, 2,2-difluoro-2-nitroethanol, and 3,3,3-trifluoropropan-2-ol were synthesized by the reaction of 1-chloro- or 1-fluoro-2,4-dinitrobenzene with the corresponding alcohol in the presence of a base. The effects of the nature of the base, reaction temperature, time of reaction, and reactant ratios on the yield of the 1,1,5-trihydroperfluoropentyl ether were studied. Author (NSA)

N66-32517# Naval Ammunition Depot, Crane, Ind.
AIR REACTIVE COMPOUNDS: LISTING AND PROPERTIES
Bernard E. Douda 24 Feb. 1966 61 p refs
(RDTR-71; AD-632686) CFSTI: HC $3.00/MF $0.75

The color, physical state, solubility, refractive index, specific gravity, melting point, boiling point, vapor pressure, viscosity, thermodynamic values, flash, fire, and autoignition temperatures, surface tension, dipole moments, and bibliographic source data are listed where applicable and available for a large number of air reactive chemicals. TAB

N66-32523# Boston Coll., Chestnut Hill, Mass.
A COMPARATIVE STUDY OF THE SPECTROCHEMICAL ANALYSIS OF A COPPER BASE SOLUTION BY THE INTENSITY LINE RATIO, THE LINE WIDTH AND THE AREA RATIO METHODS, PART II Final Report, 1 Oct. 1964–1 Apr. 1965
James J. Devlin and James F. Waterbury 23 Aug. 1965 66 p refs
(Contract AF 19(604)-1-8819)
(AFCRL-65-855(II); AD-631343) CFSTI: HC $3.00/MF $0.75

The precision of spectrochemical analysis declines in proportion to the increase in concentration of impurities for which an analysis is sought. This study endeavored to discover if it was possible to increase the precision for a copper base metal for higher percentages of lead, zinc and tin. A solution technique was followed since this at once offered the most reliable approach to preparing standards and because segregation opposes a reproducible result. Three methods of reducing the data of a large number of line pairs were followed, namely, the intensity ratio, the line width and the integrated area ratio

methods. The accumulated data shows little advantage to using the line width and the integrated ratio methods over the line intensity ratio method when lower concentrations are investigated. As the concentrations increase, however, a marked decrease in the coefficient of variation results from using the integrated ratio method. This increased precision is accompanied by additional time and effort in preparing working curves. After a curve is established, on the other hand, the method consumes a little more time than presently used methods.
Author (TAB)

N66-32550*# Gulton Industries, Inc., Metuchen, N. J. Alkaline Battery Div.
INVESTIGATION OF BATTERY ACTIVE NICKEL OXIDES Fourth Quarterly Report
P. Ritterman, S. Lerner, and H. N. Seiger 12 Jun. 1966 65 p refs
(Contract NAS3-7620)
(NASA-CR-72018) CFSTI: HC $2.50/MF $0.75 CSCL 07D

A study of the oxidation state of the sintered nickel oxide electrode, by iodometric titration, shows some agreement with the X-ray data. A study of the effect of stand, at various temperatures, on structure, was completed. Positve electrodes with cobalt, and positive electrodes with manganese additives were shown to retain 75% of original capacity after a charged stand at 65°C for 7 days. Author

N66-32569# Joint Publication Research Service, Washington, D. C.
A STUDY OF THE ABSORPTION OF HIGH-FREQUENCY ULTRASONIC VIBRATIONS IN BINARY ALCOHOL-WATER MIXTURES
A. A. Berdyyev and K. G. Akhmetzyanov 29 Jul. 1966 9 p refs Transl. into ENGLISH from Izv. Akad. Nauk Turk. SSR, Ser. Fiz. Tekh. Khim. i Geol. Nauk (Ashkhabad), no. 3, 1966 p 105
(JPRS-36-738; TT-66-33169) CFSTI: $1.00

The results obtained from measurements of ultrasonic vibration absorption in a binary alcohol water mixture whose weight concentration of alcohol was 29.9% is presented. The experimental data were obtained for the frequency range between 10 and 900 Mc, at 20°C. The results are plotted on a graph and an explanation of this graph is included. H.S.W.

N66-32580# Joint Publications Research Service, Washington, D. C.
TRANSLATIONS ON COMMUNIST CHINA'S SCIENCE AND TECHNOLOGY NO. 333, POLYMERS WITH HETEROCYCLIC STRUCTURES IN THE MAIN CHAIN
Pao-jen Wang 25 Jul. 1966 28 p refs Transl. into ENGLISH from Kao-fen-tzu T'ung-hsun (Peiking), Feb. 1966, v. 8, no. 1, p 41-58
(JPRS-36661; TT-66-33092) CFSTI: $1.00

Various polymer compounds with heterocycles in the main chain containing more stable hetero-atoms N, O, S are examined. Polyesterimides, which contain a pyrazole ring, are discussed as examples of the five-membered hetero ring containing one hetero-atom. Their heat resistance, antioxidant capabilities, radiation resistance, electric insulation, and mechanical qualities make them applicable for use in items such as films, glues, and cellulose. Polypyrazole (polymers with the main chain containing a pyrazole ring) is listed as an example of the five-membered hetero-ring systems with two hetero-atoms. Two methods for the synthesis of polypyrazole are briefly described: the condensation polymerization reaction of monomers containing pyrazole structures, and the formation of pyrazole rings during the condensation polymerization process. Properties of both polyesterimides and polypyrazole are tabulated. S.P.

N66-32594# Bureau of Mines, Boulder City, Nev. Metallurgy Research Lab.
CRYSTALLINE TITANIUM BY SODIUM REDUCTION OF TITANIUM LOWER CHLORIDES DISSOLVED IN SODIUM CHLORIDE
Vernon E. Homme and Morton Min Wong 1966 36 p refs (BM-RI-6813)

Low- and high-temperature reduction techniques were employed in a study of conditions favorable to the formation of massive titanium crystals. The low-temperature method, feeding molten sodium to solidified titanium lower chloride-sodium chloride, produced higher quality and high quantity crystalline metal. The percentage of crystalline titanium was increased with increasing reactor diameter, melt depth, and titanium dichloride concentration. The high-temperature technique, feeding molten sodium to melts above 800° C, produced needle-type crystals of lower quality and with less consistent results than the low-temperature method. Layers of titanium foil, sponge, fine needles, wool, and crusts of sintered granules were formed during the early part of the low-temperature reduction, and massive crystals were produced beneath this barrier in the latter part of the reduction. Crystalline titanium having an average hardness of Bhn 76 and representing 58 percent of the total titanium was obtained. Lamellar crystals up to 1-1/2 inches long with a hardness as low as Bhn 54 were also produced. A second-stage reduction for reclaiming titanium from offgrade sponge is described. Titanium produced by this method was comparable in quality to that from sodium reduction of titanium tetrachloride. Author

N66-32597# Library of Congress, Washington, D. C. Aerospace Technology Div.
ION EXCHANGE MEMBRANES Surveys of Soviet Scientific and Technical Information
Frederick V. Pindy 18 Apr. 1966 30 p refs Compilation of abstracts
(ATD-66-39)

This compilation of abstracts is based on Soviet open sources published 1964-1965 with a few earlier citations. The abstracts are arranged according to the institution under whose auspices the work was conducted. Following the introduction the report is divided into six sections: (1) Leningrad State University (16 entries); (2) Belorussian State University, Institute of General and Inorganic Chemistry (8 entries); (3) Institute of Physical Chemistry (4 entries); (4) Institute of High-Molecular Compounds (3 entries); (5) Institute of Electrochemistry (2 entries); (6) Other Institutions (10 entries); (7) Patents (3 entries). Work on ion exchange membranes is being conducted primarily at five centers listed above. Other institutions are doing some work in this field, and occasional patents deal with devices and methods used in ion exchange membranes. Owing to the paucity of information on ion exchange membranes in fuel cell applications, it was necessary to make the selection of articles for this report on a more general basis, according to the compiler. He notes that Soviet planners have assigned a rather high priority to fuel cell technology and goes on to discuss progress made on fuel cell technology and related subjects in the past 3-4 years. Confirmation that restrictions might have been imposed

on the publication of certain types of information concerning fuel cells and related fields is pointed out by the compiler on the basis of remarks in a review article by a Soviet author and also the scanty number of articles on the subject of fuel cells in a new monthly "Elektrokhimiya". Author

N66-32643*# Aero Vac Corp., Troy, N. Y.
EFFECT OF LOW DENSITY INERT GAS FLUSH ON OXYGEN–COLUMBIUM REACTION AT 1500°F TO 2000°F Final Report
14 May 1964 83 p
(Contract NASw-722)
(NASA-CR-76979) CFSTI: HC $2.50/MF $0.75 CSCL 07D

A process involving a controlled flowing atmosphere to provide a container with the environment desired for testing or processing of materials is investigated. The advantage of this process is cited as its ability to achieve wide ranges of impurity pressures at a minimum of gas flow and equipment cost. Methods for obtaining the desired gas pressure and velocity are described. An analytic expression was derived for the situation where a purge gas has no impurities. The sources of contaminant gases and such factors as surface migration, container outgassing, and tube outgassing were studied. An approximation for impurity concentrations is given. A set of equations was developed to obtain the minimum velocity needed and still attain the required sample concentration, and a furnace was constructed to test a purged system. Columbium–1% zirconium samples were mounted in the furnace and exposed to the resulting environment at 1500°, 1750°, and 2000°F for periods of one to ten days. Contaminant level in the samples was compared to the amount gettered in a vacuum system. Examples for application of the process are given. K.W.

N66-32651# United Kingdom Atomic Energy Authority, Harwell (England). Chemical Engineering Div.
ANALYSIS OF GAS FLOW IN A BUBBLING FLUIDISED BED WHEN CLOUD FORMATION OCCURS
B. A. Partridge and P. N. Rowe Apr. 1966 43 p refs
(AERE-R-5037) CFSTI: HC $2.00/MF $0.50

This report presents an analysis of the situation in which gas cloud formation occurs in a freely bubbling gas fluidized bed: in general the phenomenon of cloud formation occurs in the gas-fluidization of particles of 350 microns diameter or less. Expressions describing the distribution of the fluidizing gas between the cloud and interstitial flows are derived. The analysis justifies the assumption commonly made that "the excess gas above that required to fluidize the particles goes through the bed in the form of bubbles", and shows it to be consistent with present knowledge about the nature of gas clouds. Simple expressions relating bed expansion to the overall gas flow and bubble distribution are derived for both three and two-dimensional beds. These provide a link by which experimental measurements of bubble distribution in a two-dimensional bed may be related to the corresponding three-dimensional situation, for which direct determination of bubble population is impossible with existing experimental techniques. Author

N66-32653# United Kingdom Atomic Energy Authority, Harwell (England). Chemistry Div.
THE DETERMINATION OF CARBON IN STAINLESS STEEL FROM COMPATIBILITY EXPERIMENTS WITH URANIUM CARBIDE AND PLUTONIUM CARBIDE–URANIUM CARBIDE
D. Crossley and G. W. C. Milner Mar. 1966 19 p refs
(AERE-R-5192) HMSO: 2s 6d

A method is described for the determination of carbon content from 0.05 to 0.3% in stainless steels using sample weights of 25 to 30 mg. Samples are ignited in a stream of purified oxygen at 1350°C without a flux, and the carbon dioxide produced is measured manometrically. Recovery experiments carried out on an analyzed stainless steel (British Chemical Standard sample), for the determination of carbon at the 0.6% level, showed the precision of the method to be 1.5% (coefficient of variation). This method has been applied successfully to the determination of the carbon contents of small steel samples in experiments to study the compatibility of stainless steel with uranium carbide and plutonium carbide–uranium carbide mixtures. Some details are given of the compatibility experiments, of the sampling methods employed and of the results obtained. Author

N66-32657# United Kingdom Atomic Energy Authority, Harwell (England). Chemistry Div.
MASS SPECTROMETRIC MEASUREMENTS OF THE RATIO OF NEUTRON CAPTURE TO FISSION FOR ^{239}Pu AND ^{241}Pu AND OF THE ABSORPTION AND CAPTURE CROSS SECTIONS OF ^{239}Pu, ^{240}Pu AND ^{241}Pu FOR MAXWELLIAN NEUTRONS
M. J. Cabell and M. Wilkins 13 Apr. 1966 25 p refs
(AERE-R-5166) CFSTI: HC $1.00/MF $0.50

Mixtures of highly-enriched samples of ^{239}Pu, ^{240}Pu, ^{241}Pu and ^{242}Pu have been irradiated, with cobalt monitors, for nearly ten months in an almost uncontaminated Maxwellian neutron spectrum ($r=7.5\times10^{-4}$) with a temperature of 116°. Results obtained from mass analyses of the samples, both before and after irradiation are given and also the 2200 m/sec constants derived from them. Author

07 COMMUNICATIONS

Includes communications equipment and techniques; noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation.

N66-31585# American Electronic Labs., Inc., Springfield, Va.
MODIFICATION OF GENERAL AVIATION TRANSPONDER TO INCORPORATE A CRYSTAL VIDEO RECEIVER. PHASE 1: INFINITE SKIRT SELECTIVITY. PHASE 2: GAT MK I. PHASE 3: GAT MK II Final Report
Dec. 1965 79 p
(Contract FAA-ARDS-620)
(RD-65-123)

Equipment was developed for an infinite skirt selectivity crystal video receiving system to replace the existing superheterodyne receiver in the Wilcox transponder Model 814. A pulse comparator was designed to gate the signal and to achieve the infinite skirt selectivity. However, pulse distortion in the cavity of the pulse comparator made it impossible for the system to work over the required dynamic range. A modified receiver, using the previously developed equipment and a three-sectioned cavity preselector was developed, installed, and tested. The unit was within specification at room temperature

except for the side lobe suppression. The side lobe suppression was out of specification at both ends of the power input dynamic range. The receiver was further developed for installation in another Wilcox transponder this time using a nuvistor RF amplifier instead of the transistor RF amplifier. In addition, several components of the basic crystal video receiver were redesigned to improve performance or to reduce cost or weight. This modification was developed, installed, and tested. Author

N66-31732# Radio and Space Research Station, Slough (England).
OPTICAL OBSERVATIONS RECEIVED BY THE SATELLITE ORBITS GROUP FOR THE MONTH OF FEBRUARY, 1966 AND SUPPLEMENTARY OBSERVATIONS FOR THE MONTHS OF SEPTEMBER, OCTOBER, NOVEMBER, AND DECEMBER 1965 AND JANUARY 1966
[1966] 33 p
CFSTI: HC $2.00/MF $0.50

Optical observations of various satellites are tabulated. The right ascension and declination are given, and comments concerning the observations are provided. H.S.W.

N66-31743# Radio and Space Research Station, Slough (England).
OPTICAL OBSERVATIONS OF SATELLITES RECEIVED BY THE SATELLITE ORBITS GROUP FOR THE MONTH OF JANUARY 1966 AND SUPPLEMENTARY OBSERVATIONS FOR THE MONTH OF OCTOBER 1965
[1966] 32 p
CFSTI: HC $2.00/MF $0.50

This tabulation contains data from optical observations of satellites for the month of January 1966. Celestial right ascension is provided, in addition to the dates and times of the observations. The observing stations are identified. H.S.W.

N66-31744# Radio and Space Research Station, Slough (England).
OPTICAL OBSERVATIONS RECEIVED BY THE PREDICTION SERVICE (SATELLITE ORBITS GROUP) FOR THE MONTH OF DECEMBER 1965
[1965] 32 p
CFSTI: HC $2.00/MF $0.50

A tabulation of the optical observations made of satellites during December 1965 is presented. The dates and times of the observations are included, and the observing sites are identified. H.S.W.

N66-31825*# AVCO Corp., Lowell, Mass. Space Systems Div.
COMPARATIVE STUDIES OF CONCEPTUAL DESIGN AND QUALIFICATION PROCEDURES FOR A MARS PROBE/LANDER. VOLUME V: SUBSYSTEM AND TECHNICAL ANALYSES. BOOK 3: TELECOMMUNICATIONS, RADAR SYSTEMS AND POWER Final Report
John J. Mahoney et al. 11 May 1966 689 p refs
(Contract NAS1-5224)
(NASA-CR-66137; AVSSD-0006-66-RR, Vol. V, Bk-3) CFSTI: HC $7.39/MF $3.25 CSCL 17B

Detailed analyses and tradeoffs on the telecommunication, electrical power, and radar subsystems are presented for the entry from approach trajectory (EFAT), and the entry from orbit (EFO) concepts. The various reference design choices are described, the problem areas encountered are identified, and the study results and design characteristics are described. Emphasis was focused on the radar system for the EFO experimental mission, with the approach based on synthesizing a radar concept capable of satisfying the altitude measurements requirements of the flight capsule and having the potential for meeting the requirements of future planetary landers. Telecommunications research for both mission modes was directed towards systems analyses, conceptual design synthesis, and problems which might involve significant design, development, or schedule risks. Due to the short duration of the EFO mission, electrical power studies centered on the selection of a battery type and size, and a power conditioning subsystem concept for the flight capsule. For the longer EFAT mission mode, numerous alternative electrical power sources were investigated. E.A.O.

N66-31868# Radio and Space Research Station, Slough (England).
KINETHEODOLITE OBSERVATIONS OF SATELLITES RECEIVED BY THE SATELLITE ORBITS GROUP FROM MALTA FOR NOVEMBER AND DECEMBER 1965
1966 32 p /*ts* Issue No. 10
CFSTI: HC $2.00/MF $0.50

This document contains kinetheodolite observations of satellites from Malta made during November and December 1965. The tables include time, azimuth, and elevation data. R.N.A.

N66-31874# Defence Research Telecommunications Establishment, Ottawa (Ontario).
ALOUETTE 1 TIME CHARTS, JANUARY TO JUNE 1965
1 Jun. 1966 96 p
CFSTI: HC $2.50/MF $0.75

Alouette I time charts are presented which give a graphical indication of the satellite operation for the period January 1965 to June 1965. These include operation of individual experiments, housekeeping operations, or combinations of these. Alouette's four primary experiments are the topside sounder, particle counter, VLF receiver, and the cosmic noise receiver. About 80% of the recording time is used to collect sounder ionograms, but some of the time is used exclusively for VLF and cosmic noise data. The particle count experiments usually operate with any of the other experiments. Occasionally the VLF experiment and the topside sounder operate simultaneously. All data are collected and telemetered in real time. The charts show the times during which the Alouette I satellite was in operation. R.N.A.

N66-31898*# Lockheed Missiles and Space Co., Sunnyvale, Calif.
THE FIRST EXPERIMENTAL FLIGHT PACKAGE OF AN ADVANCED TELEMETRY SYSTEM WITH ADAPTIVE CAPABILITY Technical Summary Report, 1 Jul. 1963-15 Feb. 1966
J. A. Horton, H. N. Massey, and G. J. Whyte 7 Feb. 1966 85 p refs
(Contract NAS8-5110)
(NASA-CR-76515; LMSC-8-39-66-2) CFSTI: HC $2.50/MF $0.75 CSCL 09F

During this period additional study and development were accomplished, but emphasis was placed on the design, construction, and design proof test of an experimental flight package. Functional design improvements were made in the flyable system's circuit and logic design to meet the requirements of operating over a wide temperature range and at higher speeds. The system's packaging design places similar components, related to a system function, into a subassembly, resulting in

design, fabrication, and test advantages. High and low temperature tests were conducted to locate and correct additional operational problems. Environmental vibration and shock tests were also conducted followed by a high temperature–altitude test to verify conductive heat transfer to the baseplate and to test for possible system enclosure damage because of internal pressure. Test results show that the system will perform correctly within specified environments with two exceptions: correct performance was proven at temperatures up to +70°C (goal was +85°C), and the maximum false logic level at system inputs degraded from 1.3 volts at room temperature to 0.85 volts at +85° C (goal was 1.0 volt at +85° C). R.N.A.

N66-31907# Environmental Science Services Administration, Boulder, Colo. Inst. for Telecommunication Sciences and Aeronomy.

QUARTERLY RADIO NOISE DATA, DECEMBER, JANUARY, FEBRUARY 1964–65

W. Q. Crichlow, R. T. Disney, and M. A. Jenkins 14 Mar. 1966 68 p refs

(NBS-TN-18-25) GPO: $0.40

Radio noise frequency data measured for the months of December, January, and February 1964–65 by a worldwide network of stations operating in a coordinated cooperative program are presented in tabulated form. The location of the stations are pinpointed on a map. The tabulated values are based on three basic parameters of the noise: mean power, mean envelope voltage, and mean logarithm of the envelope voltage. In addition to month-hour values, corresponding values are tabulated for seasonal time blocks. Photographs of one of the recording stations, and of the recorder are presented. L.S.

N66-31922# Radio and Space Research Station, Slough (England).

KINETHEODOLITE OBSERVATIONS OF SATELLITES RECEIVED BY THE SATELLITE ORBITS GROUP FROM MALTA FOR JANUARY AND FEBRUARY 1966

[1966] 38 p *its* Issue No. 11

CFSTI: HC $2.00/MF $0.50

Kinetheodolite data of the Transit 2A (1960-07A, Eta 1), Courier 1B (1960-13B), Midas 4 (1961-28A), Transit 4B (1961-31C), Ariel 1 (1962-15A), Alouette (1962-49B), Injun 3 (1962-67B and 67F), and Thor Agena D (1963-03A) satellites as observed from Malta during January and February of 1965, are presented. The time, azimuth, and elevation tables are also given for the Explorer 17 (1963-09A), Geophysics Research (1963-26A), Thor Agena B (1963-27A), Polyot 1 (1963-43A), Ablestar (1963-49A), Explorer 19 (1963-53A), Thor Agena D (1964-11A), Elektron 3 (1964-38A), Cosmos 44 (1964-53A), Thor Agena (1964-72A), and Explorer 24 (1964-76A) satellites. L.S.

N66-31923# Radio and Space Research Station, Slough (England).

KINETHEODOLITE OBSERVATIONS OF SATELLITES RECEIVED BY THE SATELLITE ORBITS GROUP FROM MALTA FOR JANUARY AND FEBRUARY 1966 AND FROM EDINBURGH FOR APRIL 1965

[1966] 26 p *its* Issue No. 12

CFSTI: HC $2.00/MF $0.50

Kinetheodolite data of the Cosmos 54 (1965-11D), E.G.R.S. (1965-17C), Pegasus 2 (1965-39A), Cosmos 71 (1965-53F), OGO 2 (1965-81B), Cosmos 101 (1965-107B), and 1966-005A satellites as observed from Malta during January and February 1965; and of the Injun 3 rocket (1962 Beta-Tau 6) as observed from Edinburgh during April 1965, are presented. In addition to the time, azimuth, and elevation data, comments are given along with the Injun 3 rocket data. L.S.

N66-31969# Federal Aviation Agency, Atlantic City, N. J. Test and Evaluation Div.

APPLICATION OF ATC RADAR BEACON SYSTEM EXPERIMENTATION Final Report

Donald S. Schlots Feb. 1966 29 p

(RD-66-7)

The system modernization program now underway includes plans to improve the Air Traffic Control (ATC) functions through automation. Among several programs being conducted is the expansion of Mode 3 of the Military IFF Mark X (SIF) System and Modes A and C of the civil Air Traffic Control Radar Beacon System (ATCRBS). Expansion of airborne equipment provides 4096 codes in Mode 3/A and use of Mode C automatic altitude reporting. The new ground equipment provides sophisticated data acquisition, processing, and display equipment. These will provide alphanumeric (A/N) readouts on displays for the air traffic control function. A plan must be of an evolutionary nature. It must simultaneously satisfy the demands of facilities using present equipment, and facilities using modernized equipment, during a transition period. This simulation was a portion of the program directed towards development of a code employment plan for the transition period. The code plan recommended in SRDS Final Report No. 65-83, "Study of ATCRBS Code Allocation and Assignment in a NAS Environment" was used in Phase I, and modifications thereof were tested in Phase II. Author

N66-32003# Federal Aviation Agency, Washington, D. C. Spectrum Planning Branch.

DEVELOPMENT OF MANUAL RADAR INTERFERENCE PREDICTION MODEL Final Report

Robert D. Holland and Denver W. Ritchey May 1966 232 p refs

(RD-66-33)

This report describes the development and application of a theoretical model developed to manually predict the rf interference that a radar receiver may be subjected to and the effect this interference input might have on the common digitizer. A rough cull is accomplished utilizing essentially power and distance to eliminate as many equipments as possible from consideration and then more detailed calculations are accomplished on only those emitters which are potential interference sources. A series of curves have been plotted and are furnished so that propagation loss may be determined without laborious calculations. Solved examples are presented as illustration of the application of the model developed. The common digitizer portion of the prediction examines the effect of interference. The total amount of interference is examined to determine the effect on the probability of detection. Curves show that as the amount of interference increases the probability of detection decreases. Author

N66-32072*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

REAL-TIME AUTOMATIC DIGITAL OPTICAL TRACKER

Walter J. Carrion *In its* Publ. of Goddard Space Flight Center, 1963, Vol. II [1963] p 818–820 (See N66-32044 18-31) CFSTI: HC $7.00/MF $5.00

Described is a transportable optical tracking system that will give real-time angle information on passive satellites with an accuracy of better than ±5 seconds of arc for early trajectory determination from the spacecraft injection point, for midcourse lunar trajectory corrections, and for evaluation of rocket performance. It employs a two-axis antenna configuraton mount with zero readout when both axes are in level position, an automatic servodrive, and a telescope that focuses the image directly on the image orthicon on top of the main tube. The image-orthicon scan information obtained from the target is then fed directly into the computer, which determines the position of the image by comparing information obtained from consecutive scans. Shaft-angle readout encoders correct the computer for real time tracking error. G.G.

N66-32073*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
NASA PRECISION MULTI-MODE MOUNT
Walter J. Carrion and Edgar Y. Lee *In its* Publ. of Goddard Space Flight Center, 1963, Vol. II [1963] p 821–825 (See (See N66-32044 18-31) CFSTI: HC $7.00/MF $5.00

Design and fabrication of a large precision multimode mount structure that supports a 3500 lb telescope system and can operate either in the two-axis or the equatorial mode, is described. The structure consists of two-axis gimbals, a support yoke, and the base; it utilizes Meehanite castings to minimize thermal changes and hydrostatic bearings to obtain positional stability of the mounts rotational axes. Preliminary alignment tests with the tracking mount showed orthogonality and shaft wobble conditions of less than 2 arc seconds. G.G.

N66-32074*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
DIGITAL TELEVISION SCANNING SYSTEM
L. O. Caudill *In its* Publ. of Goddard Space Flight Center, 1963, Vol. II [1963] p 826–831 (See N66-32044 18-31) CFSTI: HC $7.00/MF $5.00

A technical description of a digital TV scanning system for real time optical tracking is presented together with a brief outline of planned experimental studies. The digital format for the data readout in this system is projected to the image-orthicon target from the telescope by an image-orthicon photocathode as a matrix of scanning beam positions. System timing is provided by a clock-pulse rate of 1 megacycle, indicating a minimum position-to-position time of 1 microsecond. The system has the capability to choose photocathode exposure time and the number of frame readouts per exposure. Sensitivity and resolution of the optical tracking system will be tested with several types of image tubes, as well as different scan and video amplifying techniques. G.G.

N66-32077*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
CHARACTERISTICS OF THE X-Y ANTENNA MOUNT FOR DATA ACQUISITION
Andrew J. Rolinski, Donald J. Carlson, and Robert J. Coates *In its* Publ. of Goddard Space Flight Center, 1963, Vol. II [1963] p 885–892 refs (See N66-32044 18-31) CFSTI: HC $7.00/MF $5.00

Scientific satellite programs demand optimum performance from automatic tracking antenna systems. Certain criteria, such as maximum drive shaft rates and best satellite data transmission conditions, are considered in the design of the antenna mount. In this paper, maximum shaft rates of two-axis mounts are compared under similar satellite pass conditions and the advantages of using an X-Y antenna mount for data acquisition and satellite tracking functions are discussed. Some general design considerations for servo control systems, and a discussion relating the error constants to the satellite rates, are given. A few salient features illustrating the advantages of the X-Y mount from the servo drive system designer's viewpoint are also presented. The paper concludes with a brief description of NASA's 85-foot parabolic X-Y antenna at the Data Acquisition Facility at Gilmore Creek (Fairbanks), Alaska. Author

N66-32078*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A SYSTEM FOR RE-ENTRY TRACKING OF THE APOLLO SPACECRAFT
V. Simas *In its* Publ. of Goddard Space Flight Center, 1963, Vol. II [1963] p 925–934 refs (See N66-32044 18-31) CFSTI: HC $7.00/MF $5.00

A wide beam radio interferometer system, equipped with range tracking capability, is proposed for the reentry phase tracking of the Apollo spacecraft. Since this system has no signal acquisition operational problem, it is superior to radar tracking techniques during the perturbed trajectory that is caused by variations in the reentry angle of attack. It can be housed in a mobile tracking station, together with an analog data reduction computer, a range data computer, and an X-Y plotter to produce the real time angle and the range plot of the spacecraft position. A diagram of the entire interferometer system includes orthogonal baseline oriented antenna pairs that feed four individual receiver/phase-meter channels to develop a N-S phase measurement and an E-W phase measurement, as well as ambiguity resolution measurements for each. The obtained data are then sent to a computing device which generates direction angle and angular rate in real time. G.G.

N66-32095# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON THE QUESTION OF THE APPLICATION OF RADIO-TELEMETERING DEVICES FOR THE DETERMINATION OF THE GEODETIC FIXED POINT
B. Delong 23 Mar. 1966 18 p refs Transl. into ENGLISH from Studia Geophys. Geodaet., Ceskoslov. Acad. Ved. (Prague), v. 8, no. 3, 1964 p 239–246
(FTD-TT-65-1434/1+2+4; TT-66-61130; AD-631837) CFSTI: HC $1.00/MF $0.50

The evaluation of tests of the MRA — 1/CW telemetering device by observation of the details of geodetic points which occur as a result of the compacting of trigonometric networks, is presented in this article. The application of the test in which the position and altitude of 132 points of the investigated field (i.e., detailed network of points, the precise location of which are known) are determined with the aid of the tellurometer. These tests show that radiotelemetering devices can be used with success for the observation of detailed points and that the polar method is the best and most expedient both from the standpoint of technical observation and from the standpoint of economy. The observation of detailed points by the polar method from one point were implemented with precision by characterizing the average quadratic error of position with relation to precise details of the network ±8 cm. Such precision is satisfactory for determining detailed points by means of intersections or with the assistance of markings or of auxiliary polygonometric operations. If the polar method

with two points is used, the precision in position is increased by ±5 cm which corresponds to the detailed point with high precision. Author (TAB)

N66-32125*# Atlantic Research Corp., Alexandria, Va. Jansky and Bailey Systems Engineering Dept.
TECHNICAL AND COST FACTORS THAT AFFECT TELEVISION RECEPTION FROM A SYNCHRONOUS SATELLITE Final Report
30 Jun. 1966 189 p refs
(Contract NASw-1305)
(NASA-CR-76601; TR-PL-9037) CFSTI: HC $3.25/MF $1.25 CSCL 17B

Results are reported on all factors affecting the cost and quality of television reception, as a function of effective radiated power, from a synchronous satellite. Specified are technical requirements for providing television video of defined grades of quality, and all combinations of equipment that will provide satisfactory reception. The analytical model used in the system equation, which relates the environmental parameters, the hardware parameters, and the operational requirements, was established. Cost estimate and analysis factors are given for: cost of receiver noise and modulation improvement; cost versus receiver noise at VHF, UHF, and microwave; cost versus receiver antenna gain and feed loss; and, the receiving station cost. A block diagram of the computer program used to determine the minimum cost system is presented. Appended are data on: environmental attenuation and loss factors, environmental noise, modulation analysis, and television standards. R.Ll.

N66-32147# ITT Federal Labs., Nutley, N. J.
VLF ENVELOPE TIMING EXPERIMENT Final Engineering Report, Jan. 23–Feb. 15, 1965
Oct. 1965 307 p ref
(Contract NObsr-89358)
(TD-65-387; AD-630623) CFSTI: HC $7.00/MF $1.50

Experimental equipment was developed which measures the arrival time of a pulsed VLF radio wave to high resolution. An experiment was performed wherein the NBA (naval radio station)-generated VLF signal envelope was measured at Richmond, Florida, Washington, D. C. and Nutley, New Jersey, in order to transfer time from NBA to the experimental location. A rubidium frequency standard was flown successfully between the data gathering sites and NBA to correlate the time determined by the experiment with time as transmitted by NBA. The results achieved were best for the Nutley site where the total scatter of time determinations for the final week of the experiment was contained within limiting values of −50 to ±150 microseconds with respect to time as obtained by the transport. Results achieved at Washington and Richmond showed more scatter and additionally an apparent offset from the predicted values which might be caused by improper propagation delay assumptions or calculations. Analysis of 1000 single time determinations which are averaged to produce each time measurement indicate normal distribution patterns with a probable error of the average in the 10 to 15 microsecond area. This short term equipment resolution is encouraging since it implies random signal perturbation by noise and justifies the system technique for short term measurement. Author (TAB)

N66-32162# Sylvania Electric Products, Inc., Mountain View, Calif. Electronic Defense Labs.
THEORY AND EXPERIMENT FOR HIGHER MOMENTS OF FIELDS SCATTERED BY RANDOM DISTRIBUTIONS
Thomas H. Kays and Victor Twersky 1 Nov. 1965 86 p refs
(Contract DA-28-043-AMC-00379(E))
(EDL-M809; AD-633065) CFSTI: HC $3.00/MF $0.75

Results are presented for the measurement of phase quadrature components X and Y of the field on the 5-mm microwave facility for scattering by dynamic random distributions of large spheres. Time averages $\langle X \rangle$ and $\langle Y \rangle$ are obtained electronically, and $x = X - \langle X \rangle$, and $y = Y - \langle Y \rangle$ are formed. Having isolated the departures from the average values, various products $x^n y^m$ are constructed electronically, averaged over time electronically to obtain $\langle x^n y^m \rangle$ for $0 < n+m \leq 4$ (i.e., up to the fourth moments), and then compared with theory for the analogous averages over an ensemble of gas-like configurations. Measurements and numerical computations based on theory agree adequately for the magnitudes of all moments; corresponding comparisons for the phases are off by several degrees and the cause of such discrepancies is discussed. Author

N66-32263*# RAND Corp., Santa Monica, Calif.
THE EFFECTIVE DIRECTIVITY OF AN ISOTROPIC ANTENNA LOOKING DOWN THROUGH THE IONOSPHERE
R. L. Kirkwood Jul. 1966 31 p refs
(Contract NASr-21)
(NASA-CR-76671; RM-4949-NASA) CFSTI: HC $2.00/MF $0.50 CSCL 09F

An analysis is made of the effect of the ionosphere on the apparent directivity of an isotropic antenna that looks down at the earth from a satellite. It is shown that at frequencies of more than twice the critical frequency of the ionosphere, the ionosphere has little influence on the directivity of the antenna, but at a frequency of 1.3 to 1.5 times the critical frequency, appreciable directivity is obtained. This directivity is compared to that which a broadside array would have if no ionosphere were present. Author

N66-32388# Joint Publications Research Service, Washington, D. C.
PROPAGATION OF RADIO WAVES IN INTERPLANETARY AND NEAR SOLAR SPACE
M. A. Kolosov, O. I. Yakovlev, and A. I. Yefimov, 13 Jul. 1966 10 p refs Transl. into ENGLISH from the book "Issledovaniya Kosmicheskogo Prostranstva" Moscow, 1965 p 227–233
(JPRS-36475; TT-66-32907) CFSTI: $1.00

The authors analyze four main aspects of the tracking data received from the Mars-1 probe: (1) maximum values of attenuation of monochromatic radio waves in outer space; (2) radio wave attenutation with white spectrum in near-solar space; (3) effect of the interplanetary medium on radio wave propagation; and (4) possible mechanism of radio wave attenuation. The analysis is exemplified by a table, a figure and 9 equations. Author

N66-32395# North American Aviation, Inc., Los Angeles, Calif.
APPLICATION EXPERIENCE WITH THE B-70 FLIGHT TEST DATA SYSTEM
D. B. Ince 23 Feb. 1966 17 p Presented at the 4th Intern. Aerospace Instrument Symp., Cranfield, England, 21–24 Mar. 1966
(NA-66-351)

A brief review is presented of the B-70 flight test data system's characteristics and capabilities. The airborne digital data acquisition system and its operation, the ground based data reduction facility, the airborne system's operational experience

and maintenance, modifications, and system performance are described and discussed. Some examples of the data record are included. The operational performance with the digital data acquisition system in flight testing the XB-70 has been equal to or better in all areas than was originally predicted. A second generation system, already developed and in operation, is briefly mentioned. R.N.A.

N66-32403# English Electric Co., Ltd., Whetstone (England). Mechanical Engineering Lab.

A FACILITY FOR THE ANALYSIS OF RANDOM SIGNALS

R. Lawson and A. M. Stone [1966] 49 p ref

This paper describes a data analysis facility designed for use in the fields of fundamental research and major power plant design and commissioning. The system was designed with emphasis on speed and versatility. Its operation involves a cooperative exercise between teams of instrumentation engineers, design engineers, and research engineers. The instrumentation is installed, the data collected on tape recorders, transferred to the laboratory for processing, and interpreted by research and design engineers. Manual data reduction is normally conducted during the test by experienced personnel for guidance of the plant operation and test program. The actual elements of the data reduction process are described and include data collection, data transfer, data analysis, and system analysis. The application of the data analyzer to spectral analysis with practical examples and to cross correlation analysis is discussed. The data analysis system is capable of being used as a direct on-line system analyzer and a few of its various modes of operation are discussed including transfer function analysis, automatic system analysis, and automatic frequency tracking. R.N.A.

N66-32466# Joint Publications Research Service, Washington, D. C.

INVESTIGATION OF THE PROPERTIES OF FIELD FLUCTUATIONS OF ULTRASHORT RADIO WAVES DURING PROPAGATION IN THE TROPOSPHERE

A. A. Semenov and T. I. Arsen'yan 11 Jul. 1966 33 p refs Transl. into ENGLISH from Meteorol. Issled. (Moscow), no. 9, 1965 p 203–222

(JPRS-36412; TT-66-32844) CFSTI: $2.00

Processes of radio wave propagation in media with random inhomogeneities are discussed. The nature of field fluctuations, their statistical characteristics in a space–time interpretation, and determination of the relationship between ultrashort waves and the troposphere are explained. The influence of meteorological characteristics on formation of radio signal fluctuations, and factors determining these fluctuations during tropospheric propagation are analyzed. The dependence of the fading rate on drift rate of inhomogeneities and carrier frequency of radiation is discussed. Correlation values are illustrated as a function of size of scattering inhomogeneities. Signal fluctuations of ultrashort waves in the presence of coherent field components are described, as well as an interference method for measurement of these fluctuations. The role of antenna systems in the formation of field fluctuations is considered. S.P.

N66-32468# British Aircraft Corp., Stevenage (England). Guided Weapons Div.

FLIGHT TEST RECORDING SYSTEM FOR CONCORDE

S. A. Mixsell and J. Pira [1965] 26 p Prepared jointly with Radiation, Inc., Melbourne, Fla.

A system using pulse code modulation techniques for the acquisition of large quantities of data during a flight test program is described. Information is given on the scope, capabilities, and general arrangement of the system, together with some details of the component parts. Related environment and design concepts are also discussed briefly. Author

N66-32489# Ohio State Univ. Research Foundation, Columbus. Dept. of Electrical Engineering.

REACTIVE-WALL REFLECTORS FOR 9mm MICROWAVE OPERATION Final Engineering Report, 6 Jan. 1965–6 Jan. 1966

6 Jan. 1966 12 p refs

(Contract NOw-65-0329-d)

(Rept.-1968-3; AD-633036) CFSTI: HC $1.00/MF $0.50

The accomplishments of a research program on reactive-wall corner reflectors are summarized. The use of a reactive wall on one face of a trihedral reflector to provide same-sense circular polarization response was investigated. Two corner reflector models were tested and found to perform as expected. Computer programs were developed to provide for efficient computation of the CP response of reactive-wall designs and to provide for computer optimization of reactive wall designs. Three computer-optimized designs were found to have near-maximum response over the appropriate range of incidence angles. Author

N66-32506# Harvard Univ., Cambridge, Mass. Div. of Engineering and Applied Physics.

ON THE UNIQUE DECODABILITY OF CODES Interim Technical Report

John D. Lipson Apr. 1966 11 p refs

(Contract Nonr-1866(16))

(TR-498; AD-633022) CFSTI: HC $1.00/MF $0.50

A simplification of the Sardinas and Patterson test for unique decodability is given. It is shown that duplicate sequences of code symbols generated by that algorithm can be omitted, resulting in a more efficient algorithm with respect to computer storage and time required to carry out the test. This simplicity is employed in deriving an improved upper bound on the number of sequences of code symbols that must be generated in order to determine whether or not a given code is uniquely decodable. This easily computed bound serves as a measure of the amount of computer storage and time required to carry out the test for any given code. Author (TAB)

N66-32613*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

COMPRESSION OF VIDEO DATA BY ADAPTIVE NONLINEAR PREDICTION

Joseph A. Sciulli Washington, NASA, Aug. 1966 32 p refs (NASA-TN-D-3475) CFSTI: HC $2.00/MF $0.50 CSCL 09F

Both a survey of the theory of adaptive data prediction and a description of the computer simulation of the data compression mechanism are presented. Results of simulations of the conditional expectation predictor allow comparisons with other techniques. Also included are comments on the problem of coding for a data compression system, the characteristics of the Tiros TV cloud cover pictures as an information source, and possible applications for data compression systems. Author

N66-32617*# Motorola, Inc., Scottsdale, Ariz. Military Electronics Div.
SPACE SUIT COMMUNICATION ANTENNA SYSTEM Final Report
R. S. Brazil 30 Jun. 1966 173 p refs
(Contract NAS9-4174)
(NASA-CR-65428) CFSTI: HC $3.25/MF $1.00 CSCL 09F

Several antenna configurations were developed and investigated for their use with the Apollo astronaut communication and telemetry system. Performance data for antenna configurations and mounting schemes, based upon electrical, mechanical, and environmental requirements, showed a dual frequency transmission line antenna to be most suitable for the Apollo communication system. A whip configuration evolved as a back-up or alternate antenna system; however, its input impedance and configuration were less desirable than the transmission line antenna characteristics. G.G.

N66-32625*# Electro-Voice, Inc., Buchanan, Mich. Engineering Dept.
HEADSET ASSEMBLIES Final Report
Robert C. Ramsey [1966] 34 p
(Contract NAS9-5155)
(NASA-CR-65430) CFSTI: HC $2.00/MF $0.50 CSCL 17B

Described is the construction and design of two prototype headset assemblies for use inside an Apollo-type space helmet. The completed headset consists of two noise cancelling microphones with solid state amplifiers, two dynamic earphone assemblies, and the connected mounting hardware. This headset is able to provide a 22 db signal to noise ratio with a frequency response at 5 psia within ±3 db from 300 cps to 3000 cps; the weight of the completed unit is 329 grams. G.G.

N66-32626*# Advanced Technology Corp., Timonium, Md.
ANTENNA TRIPLEXER Final Report
R. J. Bauer 16 Aug. 1965 22 p
(Contract NAS9-4602)
(NASA-CR-65431) CFSTI: HC $1.00/MF $0.50 CSCL 09F

Design and fabrication of an antenna triplexer for use in a small lightweight personal communications system is described. The purpose of the triplexer is to allow both duplex and simplex operation utilizing a common antenna and with a minimum of coaxial switching. The mechanical and electrical specifications are listed, and the evolution of a final breadboard model is summarized. Accompanying illustrations and diagrams, show the development of the breadboard package, its internal and exterior portions, the lengths of coax cable required, a plot of attenuation versus frequency for each of the three frequency channels, and the coax losses at various frequencies. For substantially improving the confidence factor of the triplexer, it was recommended that foam materials be investigated for complete potting of the unit in foam. S.P.

08 COMPUTERS

Includes computer operation and programming; and data processing. For basic research see: 19 Mathematics.

N66-31804# Oak Ridge National Lab., Tenn.
A PROGRAMMING SYSTEM FOR REMOTE CALCULATIONS
H. Katzan, Jr. 8 Nov. 1965 45 p
(Contract W-7405-ENG-26)
(ORNL-TM-1316) CFSTI: HC $2.00/MF $0.50

A programming system for performing numerical calculations in a direct-access mode from a remote console is described. Although the system can be effectively used by personnel with a variety of backgrounds, it is designed for the nonprogramming scientist or engineer. The system features a repertoire of easy-to-learn statements, one-mode arithmetic, 3 levels of subscripting, and immediate response to user's commands. Author (NSA)

N66-31855*# Lear Siegler, Inc., Grand Rapids, Mich.
A SPACECRAFT DIGITAL STABILIZATION AND CONTROL SYSTEM STUDY
H. C. Daubert, E. W. Hoffman, and T. E. Perfitt Washington, NASA, Aug. 1966 132 p refs
(Contract NASw-1004)
(NASA-CR-520) CFSTI: HC $4.00/MF $1.00 CSCL 09C

A study and experimental evaluation was performed to apply digital techniques to the problem of increasing the reliability and accuracy of spacecraft stabilization and control systems, as the sophistication and duration of spacecraft missions are increased. To meet these more stringent requirements, the use of digital systems utilizing monolithic integrated microelectronics is indicated. Author

N66-31946# European Atomic Energy Community, Brussels (Belgium).
DIFFERENCES IN THE REPRESENTATION AND FLOATING ARITHMETIC, BETWEEN THE IBM 700/7000 SERIES AND THE 360 SERIES. ROUNDING-OFF ERRORS IN THE ELEMENTARY FLOATING-POINT OPERATIONS ON THE IBM 360 COMPUTERS [DIFFERENZE NELLA RAPPRESENTAZIONE E NELLA ARITMETICA FLOATING TRA LE SERIE IBM 700/7000 E LA SERIE 360. ERRORI DI ARROTONDAMENTO NELLE OPERAZIONI ELEMENTARI FLOATING-POINT DEI CALCOLATORI DELLA SERIE IBM 360]
R. Monterosso Apr. 1966 19 p refs In ITALIAN; ENGLISH summary
(EUR-2777.i) CFSTI: HC $1.00/MF $0.50

This work contains a description of the representation of floating-point numbers, in the IBM 360 computer. The main differences between the hexadecimal representation (IBM 360) and the binary representation (IBM 700/7000) are explained. As well, for the IBM 360, upper bounds are specified for the rounding errors occuring in elementary floating-point operations on short and long format numbers. Author

N66-31972# Joint Publications Research Service, Washington, D. C.
DETERMINING ERROR IN A SYSTEM FOR AUTOMATIC CALCULATION OF TECHNICAL-ECONOMIC CHARACTERISTICS
O. V. Golovanov, P. B. Zimin, and V. A. Troitskiy 18 Jul. 1966 11 p Transl. into ENGLISH from Mekhaniz. i Avtomatiz. Proizv. (Moscow), no. 4, Apr. 1966 p 43-45
(JPRS-36543; TT-66-32975) CFSTI: $1.00

An automatic system for calculating technical-economic characteristics in determining the cost of ammonia in a chemical combine is described. Sensors for flow rate, pressure, and temperature are installed in the shops of the plant. Sensor information is transmitted to a traffic control point. The system includes ten electronic coding potentiometers, a receiver, and an expanded computer set. The computer automatically solves complex mathematical and logical problems, operating with numbers with both fixed and floating decimal points. The

system converts the information into cost and expenditure data. Formulas for all information components are given, and emphasis is placed on computational accuracy and error. K.W.

N66-32151# Navy Postgraduate School, Monterey, Calif.
THE TANGENT SEARCH METHOD OF CONSTRAINED MINIMIZATION
Roger R. Hilleary 17 Mar. 1966 88 p refs
(TR/RP-59; AD-632121) CFSTI: HC $8.60/MF $0.75

This paper describes an adaptation of the Direct Search Method which is designed to find the local minimum of an arbitrary, explicitly-stated function of more than one variable, subject to arbitrary, non-linear constraints. This is sometimes called the general problem of mathematical programming. The algorithm given here usually performs its exploratory procedure in hyperplanes approximately tangent to the constraint hypersurfaces when the base point is in the vicinity of such boundaries. Therefore, the author designates it the Tangent Search Method. Calculation of the partial derivatives of a constraint function is necessary when it is violated. However, the method never requires evaluation of any derivative of the objective function. Performance of Tangent Search on various test problems discussed in this paper is generally superior or similar to results with three other recently-published algorithms. Author (TAB)

N66-32178# University of Southern Calif., Los Angeles. Aerospace Safety Div.
INDUSTRY SAFETY INFORMATION INTERCHANGE SYSTEM. PART II: CURRENT SAFETY INFORMATION CLASSIFICATION, STORAGE AND RETRIEVAL
C. O. Miller (1965) 21 p Presented at the Univ. of Washington-Boeing Co. System Safety Symp., 8 Jun. 1965

During the past year, an exploratory study was made of information sources of probable value in the prevention of aerospace accidents. The results are presented herein. It becomes increasingly obvious that both the aerospace safety discipline in general and system safety efforts in particular are hampered by the lack of an adequate information storage and retrieval program. Improvements in this situation rest principally upon the major segments of the aerospace community since necessary funds to effect a coordinated program will only arise following acknowledgement of a requirement for a better program. Author

N66-32195# Pennsylvania Univ., Philadelphia. Moore School of Electrical Engineering.
A SURVEY OF PICTORIAL DATA PROCESSING TECHNIQUES AND EQUIPMENTS
Andries van Dam Aug. 1965 224 p refs
(Contract Nonr-551(40))
(Rept.-66-19; AD-626155) CFSTI: HC $6.00/MF $1.25

The material presented serves as a state-of-the-art report on pictorial data processing techniques and equipments; however, it is not an exhaustive report nor does it cover all the areas of pictorial data processing. The report is directed primarily to the present and future needs of the engineering data generator and user who wants to communicate in real or near real-time with his environment of digital processors. The areas covered include (1) display: consoles (and printer plotters); (2) transmission (facsimile); (3) storage and retrieval (analog); (4) optical pattern recognition; (5) graphical man/machine interaction. Author (TAB)

N66-32253*# AVCO Corp., Lowell, Mass. Space Systems Div.
JPL ENTRY VEHICLE DESIGN COMPUTER PROGRAM USERS' MANUAL
26 May 1966 714 p refs Prepared for JPL
(Contract NAS7-100; JPL-951070)
(NASA-CR-76680; AVSSD-0001-66-RR) CFSTI: HC $7.64/MF $3.50 CSCL 09B

This manual contains a series of entry vehicle design programs and input procedures. Each program and its specific purpose are described. The mathematical model used in each program and a list of basic limitations are provided. Specific equations which are programmed and descriptions of the IBM routines are also given. The intent of the programs is to ascertain the effects of all important parameters known to influence significantly the choice of vehicle shape and the calculation of the heat shield, structural, descent, and landing system weights. R.N.A.

N66-32375# National Aero- and Astronautical Research Inst., Amsterdam (Netherlands).
ASPECTS OF DIGITAL SIGNAL PROCESSING FOR FLIGHT CONTROL AND EVALUATION
D. Bosman 14 Feb. 1966 27 p refs Presented at the 4th Intern. Aerospace Instrumentation Symp., Cranfield, England, 21-24 Mar. 1966
(MP-239) CFSTI: HC $2.00/MF $0.50

Analog flight equipment possesses dynamic transfer characteristics for which no direct equivalents exist in digital computation. It is shown that these characteristics can be programmed in the computer. Distinction is made between two classes of parameters—those used for control and those used for trending—each requiring a different method for establishing the desired dynamic characteristics. Author

N66-32386# Joint Publications Research Service, Washington, D. C.
MULTICHANNEL REGULATOR CONNECTING DEVICE FOR THE DNIEPER UNIVERSAL GENERAL-PURPOSE COMPUTER
O. I. Goroshin and Yu. P. Zhuravskiy 12 Jul. 1966 8 p Transl. into ENGLISH from Mekhaniz. i Avtomatiz. Proizv. (Moscow), no. 4, Apr. 1966 p 22-23
(JPRS-36441; TT-66-32873) CFSTI: $1.00

A device is described for connecting the Dniaper general purpose controlling computer to its object. The device has thirty output trigger units for connecting the computer with signal and control relays, which are switched on and off by instructions from the control device in accordance with the computer operating program. When the computer is used for direct control of the object, these relays may control supplementary mechanisms installed on the object. Author

N66-32426# Michigan Univ., Ann Arbor. Dept. of Electrical Engineering.
A STUDY OF SYSTEM DESIGN CONSIDERATIONS IN COMPUTERS FOR SYMBOL MANIPULATION Final Report
David Chai and Jack Di Giuseppe May 1965 84 p
(Grant NSF GP-786)
(Rept.-05635-1-5)

The purpose of the study was to investigate symbol manipulation, and to determine properties which would aid the design of computers specifically for symbol manipulation. The investigation was confined to two important areas of symbol manipulation: list processing and string manipulation. Methods

of storing non-numeric information are reviewed and evaluated. Special-purpose symbol manipulation languages as well as other languages with symbol manipulation capabilities are surveyed and examined for significant properties. Some capabilities which a list processor or string manipulator should have are outlined. Certain capabilities such as pattern matching are discussed in detail. Two current symbol manipulation machines are described and the symbol manipulation capabilities of some current general purpose computers are discussed. Author

N66-32469# California Univ., Berkeley. Dept. of Statistics.
A NEW UNIFORM PSEUDO-RANDOM NUMBER GENERATOR
David W. Hutchinson Urbana, Ill., Ill. Univ., 27 Apr. 1965 20 p refs
(Grant PHS GM-10525)
(Rept.-651)

A new multiplicative congruential pseudo-random number generator is discussed in which the modulus is the largest prime within accumulator capacity and the multiplier is a primitive root of that prime. This generator appears to be superior to those in which the modulus is 2^k. In particular the least significant bits appear to be as random as the most significant bits, a property which the mod 2^k generators do not possess. The results of extensive testing of this generator on a 7094 are reported. Author

N66-32531# Rolls-Royce, Ltd., Littleover (England).
INTEGRATED DATA PROCESSING FOR A HIGH ALTITUDE SIMULATION SYSTEM
J. W. Hill and P. J. Percival [1966] 30 p Presented at the 4th Intern. Aerospace Instrumentation Symp., Cranfield, England, 23 Mar. 1966
CFSTI: HC $2.00/MF $0.50

Several alternative computer-based systems are examined for improved high-altitude test facility utilization. The major difference in the systems tested was in the location of the multiplexer and analog-to-digital converter. The system chosen was a central computer, the IBM 1710, which included an on-line random-access multiplexer and converter connected to a number of low-level analog signal cables from the test facility. Whenever possible, the technique of calibration by comparison was used with subsequent interpolation by the computer. Problems of long-term stability, nonlinearity, and hysterisis in the pressure measurement were circumvented by this technique. Test procedure for the experimental jet-engine is described, and the computer program structure for each function is discussed. The shortcomings of the system are considered, especially the use of paper tape instead of a punched card system for cutting programming time. Measurement functions and operation of the data collection unit are mentioned, and a schematic diagram of the pressure system is presented. S.P.

N66-32532# Ferranti, Ltd., Bracknell (England). Digital Systems Dept.
A NEW FLIGHT TRIALS DATA RECORDING AND PROCESSING SYSTEM
B. S. Jolly Mar. 1966 30 p Presented at the 4th Intern. Aerospace Instrumentation Symp., Cranfield, England, Mar. 1966
CFSTI: HC $2.00/MF $0.50

Because of limited instrumentation space in small aircraft, and the time length necessary to manually process large quantities of flight-trial data from larger high performance aircraft, a system for recording and processing flight test data is being developed. The airborne equipment of the integrated system consists of a digital tape recorder and a multiplexing and coding unit which accepts inputs up to 511 data channels. The ground processing equipment includes a computer to which is attached a magnetic tape unit for replaying the flight data tape, paper tape input and output equipment, a magnetic tape backing store, and digital incremental graph plotters. The various system components are described and their operations within the system are explained. The system is regarded as being in its basic form and recommendations for futher development are proposed. A.O.

N66-32542# Joint Publications Research Service, Washington, D. C.
RECOGNITION OF THE HUMAN VOICE BY A COMPUTER
30 Jun. 1966 9 p Transl. into ENGLISH from Borda (Belgrade), 16 Jun. 1966 p 8
(JPRS-36289; TT-66-32721) CFSTI: $1.00

Methods of computer recognition of spoken signals are discussed, and their applications reviewed. Two methods of recognition are described, i.e., by password and by voice. In the former, recordings are made of certain words and are coded by a spectral analyzer, which has a large selection of frequency-zone filters, and are built into the computer. The second involves recognition by color, tempo, basic tone, accent, dialect, speech defect, and intonation. L.E.W.

N66-32543# SAAB Aircraft Co., Linkoping (Sweden).
A FLIGHT TEST INSTRUMENTATION SYSTEM FOR THE SAAB A-37 'VIGGEN'
Kaare Hagestuen and Sven Sandin [1966] 28 p Presented at the 4th Intern. Aerospace Instrumentation Symp., Cranfield, England, Mar. 1966
CFSTI: HC $2.00/MF $0.50

A flight test instrumentation system using magnetic tape as the recording medium and a data handling system based on a digital computer is described. The recording, control, and signal conditioning units of the airborne system are delineated and the method for identification and marking of information is explained. The ground station consisting of reproduce equipment and a digital computer is discussed and block diagrams of the data reduction system are included. The scope of existing computer programs is also summarized. A.O.

N66-32544# Nord Aviation, Chatillon-sous-Bagneux (France).
FLIGHT TEST INSTRUMENTATION AND DATA HANDLING FOR THE TRANSALL
28 Feb. 1966 24 p
CFSTI: HC $1.00/MF $0.50

The operation of an automatic data handling system used during the flight testing of a prototype aircraft is described. Elements of the automatic data handling station are listed and the analog magnetic tape recorders are discussed. Airborne recording chain requirements, data handling principles, and the system visualization process are also presented. Data handling functions such as sorting and computing parameters, load calculations, programming, and transcoding are explained, and the use of the system in landing gear and radio navigation testing is considered. A.O.

N66-32596# Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
COMPUTER AUTOMATED DESIGN TECHNIQUES IN THE FUTURE OF AEROSPACE ELECTRONICS

Morton N. Weindling [1965] 26 p refs Presented at NAECON Conf., Dayton, Ohio, 10–12 May 1965
(Rept.-3303)

A general computer program system has been developed to perform at all or any stages of electronic design in the aerospace industry. Many of the associated functions of scheduling, purchasing, report generation, etc., are immediate products of the computer design system. The system is capable of performing the following from a description of the electronics by the functions desired: circuit analysis, logical design, simulation of the electronic system from the logical equations, selection of hardware to achieve the desired result, packaging of the system at all levels, control of all drawings and associated paper work, and preparation of control cards and/or tapes for the automatic manufacture and checking out of the electronic system. Author

N66-32596# National Bureau of Standards, Washington, D. C.
CONCORDANCE TO THE RULES OF PLACEBO V
William C. Watt and Robert W. Hsu 5 Aug. 1965 212 p ref Prepared for Natl. Inst. of Health
(NBS-8934; PB-169177) CFSTI: $2.00

A full concordance to the rules of the microgrammar Placebo V is presented, and it is pointed out that the program provides sources of the grammar symbols and rules, together with an index to show how many times the symbol occurs in each such rule. E.W.

N66-32600# Joint Publications Research Service, Washington, D. C.
MODELLING HUMAN BEHAVIOR, CONFERENCES ON PROGRAMMING, AND AUTOMATIC CONTROL
2 Aug. 1966 30 p refs Transl. into ENGLISH from Russian (JPRS-36793; TT-66-33224) CFSTI: $1.00

CONTENTS:

1. AT THE CROSSROADS OF CYBERNETICS AND PSYCHOLOGY: FIRST ATTEMPTS OF MODELLING HUMAN BEHAVIOR K. A. Ivanov-Muromskiy, E. T. Golovan', and V. S. Starinets p 1–12
2. TWO CONFERENCES ON PROGRAMMING P. F. Malyshev p 13–16
3. MACHINE OF THE FUTURE A. Dorodnitsyn p 17–21
4. "STEM" IN OPERATION M. Parfenov p 22–22A

N66-32685*# Radio Corp. of America, Van Nuys, Calif. West Coast Div.
DATA LINK EQUIPMENT FOR SATURN GROUND COMPUTER SYSTEMS Final Technical Summary Report
Oct. 1965 110 p
(Contract NAS8-11582)
(NASA-CR-76900; TP1345) CFSTI: HC $3.00/MF $0.75 CSCL 09B

Project objectives, accomplishments, system requirements, and specifications for the design and development of the Saturn ground support data link system and equipment are presented. The project plan is outlined, and the system components including the data modem assembly, control logic, maintenance and control assembly, power system, cabinet assembly, and cable simulator are functionally described. The design of the data link subsystem and major components are discussed with emphasis placed on the design philosophies applied. A summary of reliability testing and equipment failures is given, and the three basic computer programs generated for use with the data link system are delineated. The performance characteristics of the system, as observed under laboratory operating conditions, are also included. A.G.O.

09 ELECTRONIC EQUIPMENT

Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors; integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation.

N66-31869*# Martin Co., Baltimore, Md.
EFFECTS OF ELECTRON RADIATION ON UNIJUNCTION TRANSISTORS
H. L. Flescher and E. A. Szymkowiak Washington, NASA, Jul. 1966 64 p
(Contract NAS5-3734)
(NASA-CR-526) CFSTI: HC $3.00/MF $0.75 CSCL 09A

The effects of 1.5 Mev electron radiation on three different types of unijunction transistors (12 of each type) were measured. Transistor types tested were 2N1671B, 2N3980, and 2N3484 covering grown, planar, and annular construction, respectively. Parameters monitored before and after irradiation include: (1) interbase resistance, (2) valley voltage, (3) peak point voltage, (4) emitter saturation voltage, (5) intrinsic standoff ratio, (6) interbase modulated current, (7) emitter reverse current, and (8) peak point emitter current. The measured data are tabulated and presented graphically. A summary of the general observations made on each part parameter is given. The data suggest that significant changes, with some bias dependence, occur in the measured parameters at levels which range from about 5×10^{14} to 1×10^{15} e/cm^2 (E= 1.5 Mev) for the devices tested; and that the grown junction constructed device (2N1671B) is susceptible to catastrophic failure at an electron fluence level lower than that for the annular planar and diffused planar constructed devices. The data indicate that the three device types could probably be used satisfactorily at electron fluence levels ranging to about 5×10^{14} e/cm^2. L.S.

N66-31738# Institut für Plasmaphysik G.m.b.H., Garching (West Germany).
STEEP VOLTAGE TRIGGERING OF A SIMPLE TWO ELECTRODE CROWBAR GAP
J. Gruber and G. Müller Aug. 1965 26 p refs Presented at the 4th Symp. on Eng. Problems in Thermonucl. Res., Frascati-Rome, 23–27 May 1966
(IPP-4/27) CFSTI: HC $2.00/MF $0.50

The principle of triggering a simple two electrode crowbar-gap working under atmospheric pressure is discussed. By means of a low impedance 100 kV trigger generator reliable triggering in a test circuit has been achieved, giving a 44 kV, 20 nsec rise pulse at the crowbar gap. The inherent jitter of the crowbar gap was found to be only 0.5 nsec, though the overall jitter of the trigger system was 20 nsec. The gap passed a current of 60 kA when the capacitor unit was charged to 30 kV. Author

N66-31876# Technische Hogeschool, Eindhoven (Netherlands).
INTERRUPTION OF SMALL INDUCTIVE CURRENTS IN A.C. CIRCUITS

Wilhelm Maria Cornelis Van Den Heuvel (Ph.D. Thesis) [1966] 128 p refs
CFSTI: HC $3.00/MF $1.00

A survey and an explanation are given of the many cooperative phenomena which occur during the interruption of small inductive currents (1.5 to 60 amperes RMS) with high voltage circuit breakers. The study is based on the manner in which these phenomena are shown in the current through and the voltage across the breaker. Author

N66-31899*# Westinghouse Electric Corp., Irwin, Pa.
[CABLE DESIGN AND MANUFACTURING PROCEDURES] Final Report, Apr. 24–Dec. 31, 1965
John P. Tolley [1965] 79 p
(Contract NAS8-11879)
(NASA-CR-76514) CFSTI: HC $2.50/MF $0.75 CSCL 09A

This report presents the results of a program to develop and fabricate high temperature flat conductor flexible shielded cables. The cable design and materials, manufacturing procedures, testing and modification of manufacturing procedures, material quality, and experimetal runs and results are discussed. The program demonstrated the feasibility of producing single and double-side shielded cables. The only area which needs improvement is the contact between shield and shield contact conductor. Some difficulties were encountered in controlling the location of the shield contact conductor. Lamination of the 100% and 55% shield in single-side shielded cable caused a severe amount of lateral corrugation. This is caused by the shield being mechanically weaker than the core conductor. There was a tendency for the 55% shield to tear during lamination. The conductors were rounded to keep an adequate thickness of Teflon over the whole signal conductor, resulting in a more uniform Teflon flow during lamination and a slightly thinner cable. Die punching of shields is possible but the method exposes the copper edges to the environment and they may ground out. R.N.A.

N66-31927*# ITT Federal Labs., Nutley, N. J. Electron Tube Lab.
MILLIMETER-WAVE CONVERTER STUDIES Final Report, 14 May 1962–15 Jan. 1963
R. C. Wertman and R. W. Wilmarth [1963] 110 p refs
(Contract NASw-430)
(NASA-CR-76486) CFSTI: HC $3.00/MF $0.75 CSCL 09A

Feasibility studies of the fabrication of a low noise, wide bandwidth electronically tunable converter in the millimeter wave range are presented. Space charge and ballistic analyses of the operation of the backward wave converter were carried out, and low frequency converters were constructed and correlated with ballistic theory and nonlinear space charge analysis. Cold test and weak beam phase bridge measurements were made on slow wave structures, and an experimental 50 to 70 Gc backward wave oscillator tube was constructed. Electron beam studies include thick beam optics for the backward wave converter and cathode considerations. Details are also given on variation of the circuit wave amplitude and gain of the backward wave amplitude calculated from three wave theory and variation of the circuit wave and slow space charge wave and gain of the backward wave amplifier calculated from two wave theory. It was concluded that the device is practical, methods and components are within the current technology, and the weight and power requirements of the device are reasonable for use in a planetary spacecraft. L.E.W.

N66-32089# Cornell-Dubilier Electronics Div., Federal Pacific Electric Co., Norwood, Mass.
PRODUCTION ENGINEERING MEASURE FOR CAPACITORS, FEED-THROUGH, SOLID ELECTROLYTE TANTALUM PELLET Quarterly Report, Jan. 1–Mar. 31, 1966
W. G. Bailey 31 Mar. 1966 13 p
(Contract DA-36-039-AMC-03630(E))
(QR-8; AD-633062) CFSTI: HC $1.00/MF $0.50

Four lots of the required five lots of production run units were started during this quarter. All units were completed to the point of removal from formation bars after graphite and silvering. Long vendor delivery schedules of the other capacitor parts have prevented the completion of assembly of any of these four lots of capacitors. Aging and life test facilities were started during this quarter and have progressed satisfactorily. All parts for the dc leakage monitoring circuitry for the life test have been received and preliminary wiring has been started. Capacitor manufacturing and assembly, and aging and life test facilities will be continued in the coming quarters. TAB

N66-32124*# Westinghouse Electric Corp., Huntsville, Ala.
DESIGN, DEVELOP, FABRICATE AND DELIVER SILICON POWER TRANSISTORS Final Report, Jun. 1963–Oct. 1965
[1965] 123 p refs
(Contract NAS8-5335)
(NASA-CR-76603) CFSTI: HC $3.00/MF $1.00 CSCL 09A

The design, fabrication, testing, and electric properties of epitaxially deposited, silicon power transistors are discussed, and the feasibility of fabricating high voltage, high current, and high speed transistors on large area epitaxial slices proven on a small scale, engineering level. The collector and base regions were grown epitaxially and the emitter region was formed by diffusion. The transistors were hard soldered to moly and encapsulated using the compression bonding technique. Electrical tests were performed on voltage capability, and current gain; a typical display for the switching test is shown. The temperature sensitive parameter was measured by mercury relays, and tabulated data are presented for results of temperature cycling, shock and centrifuge tests, and vibration testing. R.Ll.

N66-32131*# Philco Corp., Lansdale, Pa.
DESIGN, DEVELOPMENT, FABRICATION, AND DELIVERY OF IMPROVED MOS TRANSISTORS Final Report, 21 May 1965–21 May 1966
Earl S. Schlegel Jun. 1966 234 p refs
(Contract NAS8-11926)
(NASA-CR-76639) CFSTI: HC $3.75/MF $1.25 CSCL 09A

The causes of instability, high threshold voltage, and gamma radiation sensitivity in MOS transistors were studied. A literature search showed the behavior of sodium to be a cause of instability. Tritium introduced into the oxide as tritiated water did not move in an applied field at high temperatures. Methods were developed for minimizing oxide contamination to produce stable oxides. Investigations to determine the various sources of instability, showed that alkali ion instability can be due to water used in a wet oxidation, the metalizer, or the etching or rinsing solutions used before metalization of the oxide. Reducing the positive charge in the oxide makes it possible to operate transistors at lower power levels and to design transistors less likely to fail due to shorts through the oxide. Techniques which lowered immobile charge densities include the use of different silicon orientations, the use of vapor plated oxides, thermally growing the oxide at a lower temperature, heat treating, or nickel plating the wafer

underside followed by baking. Radiation resistance was independent of whether the oxide was thermally grown or vapor plated, and independent of silicon orientation, mobile ion content, irradiation temperature, and silicon conductivity type.
R.N.A.

N66-32149# General Electric Co., Irmo, S. C. Electronic Speciality Capacitor Business Section.
PRODUCTION ENGINEERING MEASURE FOR IMPROVED RELIABILITY OF HERMETICALLY SEALED TANTALUM FOIL CAPACITORS Quarterly Report, 20 Dec. 1965-20 Mar. 1966
R. M. Trewhella [1966] 25 p
(Contract DA-36-039-AMC-06169(E))
(QR-2; AD-633057) CFSTI: HC $1.00/MF $0.50

The accomplishments during the second quarter reporting period have been the manufacturing completion and 1,000 hour 125°C operating life test results on the special capacitors in the product improvement evaluation program. There were no degradation or catastrophic failures during this 1,000 hour test interval. Efforts have continued on the work areas to improve the overall quality of the unit and to reduce in-process losses and potential capacitor failures. The Teflon end insulation has demonstrated good results by reducing the aging shorts by 70 percent. Therefore, the final design will include this type of lead insulation. A review of the wide variability with the present extraction process indicated the time capacitors soak in electrolyte to be critical. This report also includes the plans for the next quarter, list of reports issued and conferences held, and list of personnel hours expended during this period.
Author (TAB)

N66-32156# Radio Corp. of America, Princeton, N. J.
INTEGRATED LOGIC NETS Scientific Report No. 1, Jul. 1, 1964-Feb. 28, 1966
Adolph K. Rapp May 1966 19 p
(Contract AF 19(628)-4208)
(AFCRL-66-272; AD-633288) CFSTI: HC $1.00/MF $0.50

Investigations have been conducted into the technology necessary to interconnect arrays of n- and p-type MOS transistors into complementary-symmetry digital circuits. A memory module consisting of four n-type and four p-type transistors was chosen as the test vehicle. It is shown that first-level wiring on each array requires a blanket insulation between one and two microns thick to reduce wiring capacitance, and a scheme is described whereby access holes through any vacuum-deposited insulator may be obtained. The interconnection of the n-type and p-type arrays is accomplished by evaporating solder dots at appropriate points on each array, placing the arrays face-to-face, and heating in a reducing atmosphere to produce solder connections. Alignment is accomplished by looking through the silicon wafers with an infrared-to-visible light converter; the wafers are illuminated from below with a Sun Gun which also serves as the heat source when intensity is increased.
Author

N66-32202# Lewis (E. B.) Co., Inc., East Hartford, Conn.
PRODUCTION ENGINEERING MEASURE CRYSTAL UNIT CR-(XM-46A)/U Quarterly Report, 1 Nov. 1965-1 Feb. 1966
Ernest B. Lewis [1966] 23 p
(Contract DA-36-039-SC-86737)
(QR-12; AD-632698) CFSTI: HC $1.00/MF $0.50

The reasons for the failure of the 70 MC/s preproduction samples are analyzed. The problems of the instrumentation limitations with particular reference to obtaining satisfactory values of C_1 are discussed. The redesign of the 70 MC/s units with reference to flatness, plateback and spot size are explained and documented. The revised manufacturing and testing procedures now possible with the new design are presented.
Author (TAB)

N66-32257*# Westinghouse Electric Corp., Newbury Park, Calif. Molecular Electronics Div.
ANALOG VOLTAGE TO DUTY CYCLE GENERATOR Second Quarterly Progress Report
15 Jun. 1966 55 p refs Prepared for JPL
(Contracts NAS7-100; JPL-951306)
(NASA-CR-76678) CFSTI: HC $2.50/MF $0.50 CSCL 09F

A second set of system functional tests were conducted. The digital ramp generator had been replaced by an analog triangle generator. False triggering of the binary remained and was corrected by the addition of inverters to isolate the binary from the output load. Multiple triggering of the series regulators was eliminated by addition of a rolloff network in the input attenuator. After these problems were resolved, system performance and waveforms were as predicted by theory. The binary has been redesigned to incorporate the isolation provided by the inverters used in the system tests with a minimum of additional parts. Noise margin was maximized and tests performed to verify the expected noise immunity. Development of an anodic tantalum thin film capacitor technology has produced excellent devices which will more than meet the circuit requirements with a 200 mil on a side square geometry.
Author

N66-32282*# Watkins-Johnson Co., Palo Alto, Calif.
THE DESIGN AND PERFORMANCE OF A HIGH EFFICIENCY TRAVELING-WAVE TUBE, THE WJ-274 Final Report, Phase I
Lester A. Roberts [1962] 78 p refs
(Contract NAS1-3766)
(NASA-CR-77147) CFSTI: HC $2.50/MF $0.50 CSCL 09A

Spacecraft telemetry and communication systems need highly efficient, miniature radio frequency power amplifiers capable of performing during and after launch without degradation due to the severe environments to which they are subjected. This report describes the design approach and the measured performance characteristics of a traveling-wave tube. This traveling-wave tube, designated the WJ-274, delivers 20 watts power output over the frequency range 2.2 to 2.3 GHz at an overall efficiency in excess of 36.5 percent. The tube is also capable of operating over the power output range of 10 to 50 watts with good efficiency performance. It requires no modification other than to operate at a different set of voltages and currents. At power output levels of 35 watts and above, the tube exhibits an overall efficiency including heater power of 40 percent. The design basis is described, and a wide range of performance characteristics are plotted and discussed.
Author

N66-32283*# Watkins-Johnson Co., Palo Alto, Calif.
THE DESIGN AND PERFORMANCE OF A HIGH EFFICIENCY POWER CONVERSION SYSTEM FOR USE WITH THE WJ-274 TRAVELING-WAVE TUBE Final Report, Phase I
Gary S. Oleari [1966] 33 p
(Contract NAS1-3766)
(NASA-CR-66146) CFSTI: HC $2.00/MF $0.50 CSCL 09C

One of the prime requirements for spaceborne vehicles, both manned and unmanned, is that of a reliable telemetry and communications system. The nature of its application dictates that this system be highly efficient, miniature and capable of surviving severe environmental conditions with no degradation of performance. This report outlines the approach implemented to realize a power conversion system compatible with extraterrestrial environments. This system was designed, developed and manufactured specifically to supply the voltages and currents required to operate the WJ-274 traveling-wave tube, which provides the necessary radio frequency amplification to fulfill the requirement of a spaceborne telemetry and communications system. The design is analytically and empirically described and the performance characteristics discussed. These characteristics are complemented with discussion where necessary and were obtained from one of the power conversion systems in its deliverable configuration. Author

N66-32314# Aerospace Corp., El Segundo, Calif.
A LOW INDUCTANCE GASEOUS SWITCH TUBE
V. Josephson Dec. 1965 11 p Submitted for Publication
(Contract AF 04(695)-669)
(TDR-669(6550-10)-1; SSD-TR-66-72; AD-633280) CFSTI: HC $1.00/MF $0.50

A low inductance gaseous switch tube has been designed and tested which permits high current (>150,000 amp) switching of power at potentials up to 20 kv without deterioration of electrodes due to current pinching. The switch is so designed that triggering is accomplished externally with very low (<0.1 micro sec) time jitter over a wide range (5–20 kv) of operating voltages. Author (TAB)

N66-32373# Institut Franco-Allemand de Recherches, St. Louis (France).
AMPLIFIER FOR EXTREMELY SHORT COIL MEASUREMENT RANGES [VERSTAERKER FUER EXTREM KURZE SPULENMESS-STRECKEN]
A. Stenzel 30 Jun. 1965 26 p refs In FRENCH
(ISL-T-17/65) CFSTI: HC $2.00/MF $0.50

Signal amplification during the determination of the initial velocity of magnetized projectiles by means of very short coil bases is discussed. A coil base measuring device suitable for measuring coils spaced at a distance down to 20 cm is described. A detailed description is given of the signal amplifier of this device. The overall control arrangement is briefly described, and a tabulation of results of test firings is given as an indication of the effectiveness of the amplifier. Transl. by K.W.

N66-32486# Joint Publications Research Service, Washington, D. C.
AN IMAGE CONVERTER TUBE FOR MIDDLE INFRARED WITH PHOTOCONDUCTIVE LAYER AND PHOTOEMISSIVE LAYER JUXTAPOSED: THE "SERVAL"
M. Auphan, G. A. Boutry, J. J. Brissot, H. Dormont, J. Perilhou et al 26 Jul. 1966 18 p ref Transl. into ENGLISH from Infrared Phys. (Paris), v. 3, 1963 p 117–127
(JPRS-36689; TT-66-33120) CFSTI: $1.00

Principle and theory are presented for an image converter tube which is capable of functioning beyond the sensitivity threshold of the photoemissive layers, that is, throughout the spectral domain for which photoconductive layers are known whose resistivity in darkness is sufficiently high. Consideration is given to the combination consisting of an infrared sensitive photoconductive layer deposited on a semitransparent cathode, covered on its opposite face with a photoemissive coating, and placed in a vacuum. A constant potential difference is applied to this combination, the cathode is illuminated by an infrared flux, and the coating by ultraviolet. When the illumination is decreased, the resistivity of the photoconductive layer increases. The arrangement for the construction of an image converter on this principle is shown; and the operating principles of such a tube, called the serval, are discussed. M.W.R.

N66-32487# Boeing Scientific Research Labs., Seattle, Wash.
THE EFFICIENT UTILIZATION OF AN RF POWER OSCILLATOR FOR PRODUCING LOW-PRESSURE PLASMAS
Melvin J. Kofoid Apr. 1966 27 p refs
(DI-82-0522)

To produce a low-pressure plasma, i.e., in gas at 0.1–500 microns pressure, the energy transferred to the plasma then will be only a small fraction of the generator capacity because of the low power factor of the load. Simple expedients are described which result in the attainment of a much increased RF magnetic flux density in the discharge tube. The resulting increase in the plasma conductivity, hence in the load power factor, is sufficient to effect high and efficient loading. The discussion centers around the use of a 15 kW 45 kc/sec oscillator for plasma research studies. The usefulness of the generator is considerably increased by electronic control which allows times of operation as brief as 0.05 sec. Short-time operation and low average loading permit the exceeding of normal oscillator current limits to obtain high RF fields for starting and maintaining low pressure plasmas. Comprehensive performance data are presented. Author

N66-32503# California Univ., Berkeley. Electronics Research Lab.
JOINT SERVICES ELECTRONICS PROGRAM
D. J. Angelakos and J. R. Whinnery 15 Mar. 1966 73 p refs
(Grant AF-AFOSR-139-65)
(ERL-66-4; AD-632806) CFSTI: HC $3.00/MF $0.75

The Electronics Research Laboratory (ERL), University of California, Berkeley, received support for its basic research program for the Joint Services Electronics Program (JSEP), sponsored by the Departments of Air Force (Office of Scientific Research), Army (Army Research Office), and Navy (Office of Naval Research). The ERL utilizes JSEP support to cover the basic core of laboratory research. The JSEP is instrumental in supporting basic research in every research area of the laboratory which includes: bioelectronics, electron streams and interactions, plasmas, quantum and optical electronics, radiation and propagation, scanning electron microscopy, semiconductor electronics and systems and computer sciences. TAB

N66-32507# Radio Corp. of America, Somerville, N. J. Defense Microelectronics Activity.
HIGH PERFORMANCE THIN FILMS FOR MICROCIRCUITS (CAPACITORS) Third Quarterly Progress Report, 1 Sep.–30 Nov. 1965
Franz Huber and W. Witt Mar. 1966 46 p refs *Its* Rept.-3
(Contract DA-28-043-AMC-01230(E))
(CR-65-419-32; ECOM-01230-3; AD-632141) CFSTI: HC $4.60/MF $0.50

Thin-film capacitors consisting of hafnium–hafnium dioxide were fabricated and evaluated. The hafnium film is deposited onto a passive substrate by cathodic sputtering. A rate of deposition of 330 A/min permits the deposition of hafnium films with a specific resistivity of about 100 micro ohm-cm. The dielectric hafnium dioxide is produced by wet and plasma anodization. Experiments show that forming of the oxide film by plasma anodization is limited to a forming voltage (V_f) of about 60 volts as compared to 250 volts for the wet anodization process. Preliminary measurements on the dielectric constant by the 'wedge' technique show a k of 45. The temperature coefficient of capacitance for wet anodized samples has been found to be +125 ppm/degrees C between −196°C and 350°C. Measurements on the frequency dependence show that the capacitance decreases by only 3 percent at 300 kHz as compared to the 1 kHz values. Preliminary life tests at +125°C show that thin-film hafnium–hafnium dioxide capacitors prepared by wet anodization exhibit a high stability as compared to plasmonically-anodized hafnium–oxide thin-film capacitors. Author (TAB)

N66-32513# Martin Co., Baltimore, Md.
RADIATION EFFECTS ON INSULATED GATE FIELD EFFECT (MOS) INTEGRATED CIRCUITS First Quarterly Report, 1 Jul.–30 Sep. 1965
David M. Long, Harold L. Flescher and Stanley E. Harrison Apr. 1966 59 p refs *Its* Rept.-1
(Contract DA-28-043-AMC-01520(E))
(ECOM-01520-1; AD-630344) CFSTI: HC $6.60/MF $0.75

The preliminary theoretical analysis of permanent radiation effects on MOS devices indicates that after 10^{14} neutrons/sq cm the average carrier mobility in the channel decreases about 5%, the reverse leakage current of the drain-substrate p–n junction (I_{pno}) increases by a factor of 10 to 100, the terminal capacitances (C_{gs}, C_{gd}, and C_{ds}) are not significantly changed except for the bias dependence of the channal capacitance which is influence by shifts in threshold voltage (V_T), and the drain current transconductance, and channel conductance are significantly influence by the variations in V_T. The predicted changes in V_T due to bulk damage in the substrate are too small to account for the V_T changes observed experimentally by several workers in the field. The changes in V_T are apparently caused by a redistribution of charge in the oxide, but the exact damage mechanism has not been established at this time. The analysis of transient effects revealed that the dominant response mechanisms are charge scattering from the device leads; leakage resistance as dictated by ionization of the gas inside the encapsulated device; transient gate current resulting from the generation of carriers in the transverse electric field of the channel; and transient drain current resulting from the primary photocurrent of the drain p–n junction. TAB

N66-32518# ITT Electron Tube Div., Easton, Pa.
PRODUCTION ENGINEERING MEASURE FOR A PHASE II SUPER POWER HYDROGEN THYRATRON TUBE Quarterly Progress Reports, 7 Sep. 1965–6 Mar. 1966
H. E. Krefft [1966] 29 p
(Contract DA-36-039-SC-85985)
(QPR-15; QPR-16; AD-632709) CFSTI: HC $2.00/MF $0.50

Evaluation of tube no. 13, design "A", made for assessing manufacturing conditions at the Easton plant, did not show an imrovement over previous tubes, changes in the grids of tube no. 14 were made in accordance with the program of work outlined in the previous progress report (AD-629 287). A baffled box type gradient grid was substituted for the original one plate grid, and baffling of the control grid was increased. Improved performance at low repetition rates was observed, but evaluation at high PRR under specified conditions was not possible owing to continued failures of the phase II test modulator. A general overhaul of the set was initiated. Author (TAB)

N66-32563# Royal Aircraft Establishment, Farnborough (England).
THE INFLUENCE OF THE RADIAL HEIGHT OF A POLE ON THE PICTURE OF THE MAGNETIC FIELD IN AN AIR GAP [VLIYANIE RADIAL'NOI VYSOTY POLYUSA NA KARTINU MAGNITNOGO POLYA V VOZDUSHNOM ZAZORE]
Z. K. Sika Apr. 1966 20 p refs Transl. into ENGLISH from Beskontaktnye Elektr. Mashiny (Riga), v. III, 1963 p 29–42
(RAE-LIB-TRANS-1158) CFSTI: HC $1.00/MF $0.50

The effect on the air-gap flux distribution of the claw type alternator, due to the variation in pole height at different cross-sections of the field system is investigated by the method of conformal transformations. It is shown that the height of the pole has little effect on the flux distribution on the surface of the armature and that in practical calculations this effect can be disregarded. Author

N66-32584# Joint Publications Research Service, Washington, D. C.
PLASMA AND ELECTRONIC SUPER-HIGH FREQUENCY AMPLIFIERS AND OSCILLATORS
G. A. Bernashevskiy, Ye. V. Bogdanov, V. Ya. Kislov, and Z. S. Chernov 28 Jul. 1966 93 p refs Transl. into ENGLISH of the booklet "Plazmennyye i Elektronnyye Usiliteli i Generatory SVCh" Moscow, Sov. Radio, 1965 p 1–96
(JPRS-36717; TT-66-33148) CFSTI: $3.00

The physical principles governing the use of a plasma for the generation and amplification of super high frequency oscillations, and for the interaction of plasma oscillations with an electron beam are treated. The basic properties of the interaction which can be employed in building plasma amplifiers and oscillators are disclosed. Additionally, centrifugal electrostatic focusing (TsEF) of spinning electron fluxes is discussed; and super high frequency amplifiers and oscillators whose design is based on such focusing are considered. The stability of an electron flux during the use of TsEF was analyzed and the ultimate value of the current was determined. H.S.W.

N66-32604# Joint Publications Research Service, Washington, D. C.
SOVIET MEDIUM-POWER AND HIGH-POWER MONOCRYSTAL SEMICONDUCTOR RECTIFIERS, PART III
E. Bura 4 Aug. 1966 10 p refs Transl. into ENGLISH from Elektrie (E. Berlin), no. 6, Jul. 1966 p 247–248
(JPRS-36850; TT-66-33280) CFSTI: $1.00

Two types of symmetric seminconductor rectifiers are discussed; (1) symmetric selective silicon rectifiers; and (2) symmetric controllable and selective silicon rectifiers. The rectifiers are composed of a monocrystal silicon disc with five-layer structure n–p–n–p–n mounted on a metal body for contact and dissipation of heat. It is pointed out that compared with customary four-layer power diodes and thyristors, these rectifiers are protected against overvoltages. Design and technical specifications are briefly given. A letter code type designation for these Soviet-made rectifiers is explained. K.W.

N66-32627*# Space Craft, Inc., Huntsville, Ala.
QUALIFICATION TEST PROCEDURE FOR MULTICODER, MICROMINIATURE HIGH LEVEL
[1966] 84 p
(Contract NAS 9-4396)
(NASA-CR-65432) CFSTI: HC $2.50/MF $0.75 CSCL 09C

Pre-environmental, environmental, and post environmental tests for the microminiature high-level multicoder are outlined. The pre-environment acceptance test for specification requirements lists methods, test equipment, and equipment connection diagrams, and includes a functional test of voltage, current, power reversal, ripple, feedback, susceptibility, impedance, overvoltage, linearity, crosstalk, output, scattering, pulse, and temperature properties. Environmental testing is for proper operation during launch, deep space, and reentry conditions; test equipment and methods are listed, and testing is for thermal shock, altitude, acceleration, shock, noise, vibration, atmosphere, sand and dust, and interference. The post environmental acceptance test is identical to the pre-environmental test except that it does not include temperature tests. K.W.

N66-32654# United Kingdom Atomic Energy Authority, Harwell (England). Electronics and Applied Physics Div.
THE DEVELOPMENT AND APPLICATION OF Li-DRIFT GERMANIUM DIODES AT A.E.R.E.
P. E. Gibbons May 1966 30 p refs
(AERE-R-5206) HMSO: 4s

This paper gives a "state of the art" account of detector fabrication and developments in cryostat design and low noise head amplifiers, using field effect transistors. Present applications and future requirements are summarized. Author

N66-32672*# Electra Mfg. Co., Independence, Kan.
ACCELERATION FACTOR DETERMINATION FOR METAL FILM RESISTORS Quarterly Progress Report No. 2
G. A. Swartz 15 Jan. 1966 41 p
(Contract NAS8-11076)
(NASA-CR-76849) CFSTI: HC $2.00/MF $0.50 CSCL 09A

This report covers results of screen test vs life test data obtained in the initial contract and the infra-red measurements made under the contract modification. Correlation coefficients for temperature cycle, burn-in, and initial noise vs load life are given. Regression lines are shown for burn-in vs load life. While this data indicates that burn-in is an effective screen test, it also indicates the need for further study on larger samples. Infrared profiles were taken on all resistors to be life-tested resulting in 9900 profiles on 1800 pages. Examples of the profiles are shown. However, no conclusions or correlation can be made until completion of the 2000 hour load life test. Author

N66-32679*# Auburn Research Foundation, Inc., Ala.
RADIO FREQUENCY SYSTEMS. MILLIMETER WAVES STUDY Seventh Quarterly Progress Report, 1 Sep.–1 Dec. 1965
[1965] 30 p
(Contract NAS8-11184)
(NASA-CR-76916) CFSTI: HC $2.00/MF $0.50 CSCL 09C

Temperature testing of a 380-MHz oscillator for a 2280-MHz television exciter unit indicated that some form of temperature compensation was necessary if a stable output frequency was to be obtained. An effort was made to gain improved frequency stability with a combination 190-MHz oscillator and doubler stage. Design of a power amplifier was modified into a common-base transistor configuration to provide better isolation between the oscillator and the X6 multiplier. Packaging of a solid state 28-Vdc power supply for the exciter unit was initiated. Space available in the exciter unit package for the power supply required a reduction in the total volume of a model that was received. Schematic diagrams and circuit component values are given for all equipment that is discussed. Progress on a millimeter wave study is briefly mentioned. K.W.

10 ELECTRONICS

Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see: Specific Physics Categories.

N66-31654# Air Force Academy, Colo. Frank J. Seiler Research Lab.
THE CONTROL OF UNSTABLE MECHANICAL SYSTEMS
John F. Schaefer *In* Office of Aerospace Res. Proc. of the Res. Appl. Conf. [1966] p 131–139 refs (See N66316A8 18-34) CFSTI: HC $5.00/MF $1.00

Research directed toward the control and controllability of a particular type of unstable mechanical system, one whose dynamic behavior is similar to that of a rocket booster at liftoff, is discussed. The subject device consists of a thin, flexible beam hinged at its lower end to a motorized cart. Like the rocket booster, the beam tends to fall over unless corrective lateral thrusts are applied to the cart. Because the beam is a distributed-parameter system capable of an infinite number of degrees of freedom, the actual device was approximated with a lumped-parameter model yielding ordinary differential equations of motion. It is suggested that this theory might be applied in the development of a highly mobile, quickly erectible, communications antenna. It would consist of many rigid segments, folding upon one another, on a mobile base. The segments, or links, would be erected one at a time by the erection mechanism while the mobile base moves horizontally so as to keep those links already raised vertical. C.T.C.

N66-31659# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
RECORDS OF AUTOMATION AND TELEMECHANICS (SELECTED ARTICLES)
15 Mar. 1966 42 p refs Transl. into ENGLISH from Arch. Automatyki i Telemechaniki (Warsaw), vol. 9, no. 12, 1964 p 133–148, 167–177
(FTD-TT-65-902/1+2+3+4; AD-631836) CFSTI: HC $2.00/MF $0.50

CONTENTS:

1. DEPENDENCE OF OPTIMUM CONTROL ON THE PARAMETERS OF THE CONTROLLED OBJECT R. Kulikowski p 1–22 refs (See N66-31660 18-10)
2. ON A CERTAIN PROBLEM OF HIGHER-LEVEL CONTROL A. Straszak p 23–37 refs (See N66-31661 18-10)

N66-31660# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DEPENDENCE OF OPTIMUM CONTROL ON THE PARAMETERS OF THE CONTROLLED OBJECT

Roman Kulikowski *In its* Records of Automation and Telemechanics 15 Mar. 1966 p 1–22 refs (See N66-31659 18-10) CFSTI: HC $2.00/MF $0.50

In the theory of optimum control, it is generally assumed that the controlled object is a given fact from the outset. In the present paper it is assumed that the parameters of the object, such as the order of the operational transfer function, the positions of poles and the points of application of control forces may be varied, and the influence of variation of these parameters on dynamic error is ascertained. The conclusions drawn from the analysis may be helpful in the design of controlled objects from the standpoint of obtaining optimum performance from the entire complex system, from a controlled object that is optimal in a certain sense, and from an optimal controller. Author

N66-31661# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ON A CERTAIN PROBLEM OF HIGHER-LEVEL CONTROL

Andrzej Straszak *In its* Records of Automation and Telemechanics 15 Mar. 1966 p 23–37 refs (See N66-31659 18-10) CFSTI: HC $2.00/MF $0.50

A problem of higher-level control involving automatic control of optimum local systems connected with one another by a common source of control current is formulated. In many cases, this problem can be cast in the form of a program. Examples that admit of reduction to programs, linear and nonlinear, are presented. Author

N66-31781# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.

COMPLEX NORMALIZATION OF SCATTERING MATRICES AND THE PROBLEM OF COMPATIBLE IMPEDANCES

M. R. Wohlers Jun. 1965 40 p refs

(RE-214J)

A new complex normalization procedure for scattering matrices is reviewed and an existence theorem is presented for determining whether a given matrix is the scattering matrix of a passive system with a known complex normalization. The new technique is applied to the problem of impedance transformation using lossless networks (compatible impedances), and it is shown to lead to its complete solution. Examples which illustrate the procedure are given. Author

N66-31976# Joint Publications Research Service, Washington, D. C.

CYBERNETICS AND THEORY OF CONTROL

G. M. Adel'son-Bel'skiy and A. A. Leman 18 Jul. 1966 11 p Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 167, no. 4, 1966 p 772–774

(JPRS-36534; TT-66-32966) CFSTI: $1.00

An algorithm is presented for fast detection of pseudomaxima of function, shown on an integral grid, using a limited memory. Author

N66-31992# Physics Lab. RVO-TNO, The Hague (Netherlands).

NOISE IN IMAGE INTENSIFIERS AND PHOTO MULTIPLIERS

Ir. C. van Schooneveld Nov. 1965 45 p refs

(Ph.L.1965-42; TDCK-45479) CFSTI: HC $2.00/MF $0.50

A number of stochastic variables such as noise currents, fluctuating numbers of particles, and stochastic gain factors are considered. It is shown that an image intensifier or a photomultiplier can be viewed as a chain of elements that are connected in series, with the input and output processes of each element being streams of particles. An N stage image intensifier, together with the lens and retinal of the observer's eye, is considered and regarded as a particle amplifier with a fluctuating gain. Formulas are derived for the mean value and the relative variance of the gain. It was concluded that in a well-designed image intensifier, the relative variance of the spikes image depends only on the efficiencies of the first two cathodes, the coupling loss between the first and second stage, and the average gain of the first stage. Only the noise of the signal current is examined for the photomultiplier, which is statistically regarded as a simplified image intensifier, and statistics of the current through the anode impedance are derived. S.P.

N66-32108*# Honeywell, Inc., St. Paul, Minn.

MINIMAX STUDIES

W. A. Glasser, K. D. Graham, and C. A. Harvey Washington, NASA, Aug. 1966 107 p refs

(Contract NAS8-11206)

(NASA-CR-547) CFSTI: HC $4.00/MF $0.75 CSCL 12A

Two brief studies of the effect of non-zero initial conditions on the performance according to the minimax criterion and on the selection of minimax controllers from a given set of controllers are reported. The results of two studies of extremal bounded amplitude, bounded rate inputs to linear systems are also reported. The first study considers one flight condition for a Saturn V type vehicle with first order gimbal dynamics. The control configuration has pitch rate, lagged pitch attitude and normal acceleration feedbacks. Each optimal controller had one positive pole, one negative pole, and a stable complex pair of poles. The second study considers two flight conditions for "Model Vehicle Number 2 for Advanced Control Studies" with no gimbal dynamics. The control configuration has pitch attitude, pitch rate, and lateral velocity feedbacks. The optimal gains are monotone functions of the magnitude of initial conditions. The first study of extremal inputs is restricted to an oscillator. The theoretical development indicates the relation between several sets of necessary conditions and one sufficient condition. One set of necessary conditions is shown to be sufficient and from these conditions general explicit formulas for extremal inputs are derived. The last study pertains to the development of computational algorithms for extremal inputs for general linear stationary systems. Two algorithms are presented, and an example of computer results obtained from one algorithm is given. Author

N66-32120*# Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.

BENDING FEEDBACK CONTROL Final Report

W. K. Waymeyer Jun. 1966 304 p refs

(Contract NAS8-20087)

(NASA-CR-76557; DAC-59275) CFSTI: HC $4.25/MF $1.75 CSCL 09C

The results of a 12-month study of the application of quadratic optimal control, least squares state, and parameter estimation to the stability and control problem of the flexible launch vehicle are presented. The feasibility of using optimal control on a few states of a high-order system to control the damping in the bending modes is demonstrated. State estimation (Kalman) filters are shown to be capable of stabilizing the higher-order bending modes. Combined state and parameter estimation is shown to be straightforward, although

rather complex in mechanization. A set of control gains and filters is derived for a particular model vehicle provided by NASA-MFSC. This model, based on the general characteristics of Saturn V, is specifically tailored to make it difficult to stabilize. It is shown that the methods described can stabilize this model at three sample flight conditions which represent the extremes in the environment. A set of design guides, or principles, for the application of these techniques is presented. It is suggested that these techniques raise the capacity of the control system designer to the consideration of better and higher-order systems than have been readily tractable heretofore. Author

N66-32132*# National Aeronautics and Space Administration, Washington, D. C.

ELECTROMAGNETIC COMPATIBILITY PRINCIPLES AND PRACTICES

Oct. 1965 709 p refs

(NASA-TM-X-57763; NHB-5320.3; RA-016-001-1) CFSTI: HC $7.59/MF $3.50 CSCL 09C

This manual on electromagnetic compatibility (EMC) principles and practices was prepared as a constructive aid to the NASA Apollo team. The text covers EMC history and background; EMC organization; an EMC program evaluation; elements of electromagnetic interference (EMI); theoretical aspects of EMC analysis; electromagnetic characteristics of electronic parts, functional circuits, and components; grounding; bonding; shielding; packaging and equipment interfacing; filter design and application; design considerations for minimizing interference; EMI specifications; control and test plans; interference measurements, test equipment, and conditions; susceptibility; and measurement techniques. R.N.A.

N66-32142*# Illinois Univ., Urbana. Coordinated Science Lab.

COORDINATED SCIENCE LABORATORY PROGRESS REPORT FOR SEPTEMBER–NOVEMBER 1965

21 Jan. 1966 123 p refs

(Grants NsG-376; NsG-443; NsG-504; NGR-14-005-038; NSF GK-36 et al)

(NASA-CR-76574; AD-627094) CFSTI: HC $3.00/MF $1.00 CSCL 09C

Technological developments are reported for data reduction, switching and control systems, plasma physics, thin films, superconductors, and related topics. The problem of photographic observability and the effect of micrometeorite cratering on determining the optimal diameter of the gyro satellite are discussed. The increased sensitivity of the high-resolution electron spectrometer is reported. Bubble-chamber data processing, and new computer display equipment are listed. The following topics are also mentioned: parameter-variation problem, stability of nonlinear systems, computer-oriented formulation and solution of the optimal control problem, plasma display tube, low-pressure pumping speeds of getter-ion pumps, beam–plasma interaction, collisionless damping, superconducting parametric amplifier (picovoltmeter), computer-aided design and dynamic analyses of structures, and the propagation of errors in finite memory encoding–decoding schemes. R.LI.

N66-32197# Lincoln Lab., Mass. Inst. of Tech., Lexington.

GENERAL RESEARCH Quarterly Technical Summary, 1 Nov. 1965–31 Jan. 1966

Frederick C. Frick et al 5 Apr. 1966 61 p refs

(Contract AF 19(628)-5167)

(ESD-TDR-66-31; AD-630918) CFSTI: HC $6.60/MF $0.75

Summaries are given of progress and results in the following research areas: digital computers (computer systems, circuit development, magnetic film engineering, system programming and applications); computer components (magnetic films, optics, electron transport); psychology (man-computer interaction, human information processing); control research (computation center development, hybrid computational facility); surveillance techniques (space surveillance, lunar studies, planetary studies, atmospheric studies, radio astronomy); microwave components (Haystack microwave components, solid-state amplifiers, millimeter-wavelength program, modification to tradex error horns); mechanical engineering (haystack, solid state research, laser radar, structures research); physical plant engineering (Haystack Hill, Millstone Hill); control systems (Nike–Ajax optical mount, Haystack); solid state device research; optical techniques and devices; materials research; physics of solids. TAB

N66-32293*# California Univ., Berkeley. Electronic Research Lab.

COST-FUNCTION CHARACTERIZATION OF SYSTEMS

D. Chazan 31 Mar. 1966 96 p refs

(Grant NsG-354)

(NASA-CR-76731; ERL-66-5) CFSTI: HC $2.50/MF $0.75 CSCL 09C

Cost functions are used to describe dynamical control systems. The generalized approach is first introduced and some of its applications studied, and then it is shown that, despite the generality of the approach, it can be made to yield, at least in special cases, the strong results obtained by classical techniques. An analogy with probability theory, which hinges on the similarity between the Markov transition cost functions and the Chapman–Kolomogorov equation, is discussed. Terms used to bring out the probability analogy are defined. A class of Markov transition cost functions satisfying a linearity and time-invariance condition is characterized. Finally, several examples of the optimal control problem are given. L.E.W.

N66-32294*# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.

MINIMUM TIME CONTROL OF A NONLINEAR SYSTEM

José Louis Garcia Almuzara and I. Fluegge-Lotz May 1966 127 p refs

(Grant NsG-133-61)

(NASA-CR-76729; SUDAAR-271) CFSTI: HC $3.00/MF $1.00 CSCL 09C

The time-optimal control problem is investigated for a system that can be represented by a second-order nonlinear differential equation. Pontryagin's maximum principle and an existence theorem by Filipov were used to prove that this optimal control exists, and that it must be of the form of a piecewise constant function of time. The time-optimal control problem has been solved for two families of periodic functions: (1) periodic functions which are at the same time antisymmetric, and (2) periodic functions that, without being antisymmetric, satisfy a certain Lemma. Author

N66-32393# Joint Publications Research Service, Washington, D.C.

SELF-LEARNING PICKUPS, SELF-ADAPTIVE SYSTEMS AND OTHER PROBLEMS OF TECHNICAL CYBERNETICS

15 Jul. 1966 47 p refs Transl. into ENGLISH from Avtomatyka (Kiev), no. 2, 1966 p 34–64

(JPRS-36527; TT-66-32959) CFSTI: $2.00

CONTENTS:

1. SELF-LEARNING PICKUPS V. I. Vasil'yev p 1–13 refs

2. COMMON AND DISTINGUISHING FEATURES OF THE BASIC PROBLEMS OF TECHNICAL CYBERNETICS O. G. Ivakhninko p 14–34 refs

3. RELATIONSHIP BETWEEN NON-HUNTING SELF-ADAPTIVE SYSTEMS WITH AN "AUXILIARY OPERATOR", DIFFERENTIAL SYSTEMS, AND SYSTEMS BASED ON THE SENSITIVENESS THEORY V. I. Kostyuk p 35–44 refs

N66-32432*# Autonetics, Anaheim, Calif.
A SELECTED ANNOTATED BIBLIOGRAPHY FOR SPACE-BORNE MULTIPROCESSING STUDY
C. F. C. Lyau 31 May 1966 54 p refs
(Contract NAS12-108)
(NASA-CR-76756; T6-1225/3111) CFSTI: HC $2.50/MF $0.50 CSCL 09C

This bibliography is prepared to provide readily available references on the work which has been accomplished in industry related to the application of multiprocessor systems to space missions. The bibliography includes references in the following categories: checkout and fault isolation, control systems, distributed logic and SOLOMON computer; space missions and spaceborne processing; time-sharing and multiprocessing multicomputers, and associated subjects. There are 115 references which include reports, papers, periodical articles, and books covering the period 1960 through February 1966. Author

N66-32605# Joint Publications Research Service, Washington, D. C.
SECOND SYMPOSIUM ON EXTREMUM PROBLEMS IN RIGA
L. Rastrigin 2 Aug. 1966 16 p refs Transl. into ENGLISH from Latvijas PSR Zinatnu Akad. Vestis (Riga), no. 2, 1966 p 119–127 Symp. held at Riga, 25–28 May 1965
(JPRS-36789; TT-66-33220) CFSTI: $1.00

Various presentations relating to the problems of information retrieval and optimal control were discussed. The following subjects are included: algorithms, random noise effects, error detecting codes, search methods, discretization, machine recognition, [illegible], set theory, computer systems, and mathematical programming. The methods are discussed in the context of their application to various problems in production and industrial processes. K.W.

N66-32634*# Purdue Univ., Lafayette, Ind. School of Electrical Engineering.
INVESTIGATION OF OPTIMIZATION OF ATTITUDE CONTROL SYSTEMS Second Annual Report, 15 Sep. 1965–30 Jun. 1966
J. Y. S. Luh [1966] 99 p refs Prepared for JPL
(Contracts NAS7-100; JPL-950670)
(NASA-CR-76956) CFSTI: HC $2.50/MF $0.75 CSCL 17G

A general theory for linear autonomous systems was developed and applied to deriving a method for determining the optimal control in bounded phase coordinate processes. As an illustration, the time-optimal control of an unstable booster with actuator position and rate limits was studied. A flexible vehicle subject to wind disturbances was also considered. In this case, the ratio of actuator position to its rate plays an important role in the extremal control law. The control variable was found to enter and exit from its bound as often as the time duration permitted. In both examples the optimal controls are expressed as explicit time functions. The optimal control of antenna pointing direction was investigated. The problem was formulated so that the pointing direction is kept within an accepted region with maximum probability all the time. A controller forces the antenna to point in a desired direction by minimizing the error rate of information transmission. The problem was reduced to the determination of a controller which maximizes the probability, and a computational scheme based on an iteration procedure was developed. E.A.O.

11 FACILITIES, RESEARCH AND SUPPORT

Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations.

N66-31551# Sandia Corp., Albuquerque, N. Mex. Sandia Lab.
DESIGN AND PERFORMANCE CHARACTERISTICS OF A WATER JET ACTUATOR
Robert L. Henderson *In* NRL The Shock and Vibration Bull. No. 35, Pt. 6 Apr. 1966 p 47–54 ref (See N66-31546 18-32) CFSTI: HC $7.00/MF $1.75

In response to a need for a velocity generator to provide a 400-fps impact velocity with a 3000-lb test sled, a Water Jet Catapult was designed and fabricated. The design of the facility is discussed, along with a description of the major components and the predicted and measured performance of the facility. Reference is also made to a small low-velocity generator, designed using the same basic principles. Author

N66-31556# Radio Corp. of America, Princeton, N. J. Astro-Electronics Div.
EXTENSION OF SHAKER SHOCK CAPABILITIES
James M. Mc Clanahan and John Fagan *In* NRL The Shock and Vibration Bull. No. 35, Pt. 6 Apr. 1966 p 111–118 refs (See N66-31546 18-32) CFSTI: HC $7.00/MF $1.75

The scope of this evaluation (the extension of shaker shock capabilities by dc biasing the driver coil) is limited to data obtained by double integration of the acceleration waveform. This determination of the positive and negative displacement from a zero-deflection position of the shaker moving element indicates possible extension of shock capability. The mathematical evaluation of acceleration data indicated that the extension of capability is worth the cost of a biasing unit. The greatly improved frequency response of the overall shock console allows for more repeatable control of the undershoot by greatly reducing the interaction between the leading edge and trailing edge of the input pulse. This increased control of undershoot provides an increase of shaker shock acceleration capability in long-time-duration half-sine shock pulses with the specimen coupled to the moving element. It is not anticipated that sawtooth shock capability will be extended with the improved control, due to the low axial resonance and the shaker-and-power amplifier dynamics. Author

N66-31557# Naval Weapons Station, Seal Beach, Calif. Quality Evaluation Lab.

A NEW AIR GUN FOR SHOCK TESTING

Evan W. Gray and Tom B. Linton *In* NRL The Shock and Vibration Bull. No. 35, Pt. 6 Apr. 1966 p 119–140 (See N66-31546 18-32) CFSTI: HC $7.00/MF $1.75

Water entry subjects a weapon to unique two-phase shocks, consisting of a high-g, short-duration, spike phase at splash, followed by an in-water drag phase, wherein an initial acceleration decays as the weapon approaches a terminal sinking velocity. The U.S. Naval Weapons Station at Seal Beach, through the facilities of the Quality Evaluation Laboratory, has the task assignment of simulating the water entry tests on pre-production and periodic production samples of SUBROC weapon components. Guidelines for the air gun design to perform the tests came from the U.S. Naval Ordnance Laboratory at White Oak, in the form of test specifications and air gun methods of test as developed at that Laboratory. Author

N66-31558# Watervliet Arsenal, N. Y.

INVESTIGATION OF PARAMETERS AFFECTING DYNAMIC PRESSURES IN SUPER PRESSURE GENERATOR USED FOR CANNON BREECH FATIGUE STUDIES

R. R. Lasselle, J. E. Zweig, and M. A. Scavullo *In* NRL The Shock and Vibration Bull. No. 35, Pt. 6 Apr. 1966 p 141–148 (See N66-31546 18-32) CFSTI: HC $7.00/MF $0.75

A series of pressure–time pulse records were made using the superpressure generator to investigate test parameters for maximizing the thrust capability of the facility. The pressure gradients existing in the chamber of the test weapon and the factors governing them were also examined. The pressure–time pulse was provided by impacting a 20,000-lb hammer on a piston, and the pulse was sensed by pressure gauges in the top and bottom of the pressure vessel. Tests were conducted with various hammer drop heights and top clearances for a given bottom clearance and annulus. The characteristic pressure pulses have a general half-sine form with certain deviations apparently created by the fluid properties. It was ascertained that a uniform pressure can be obtained in the weapon chamber if certain combinations of top and annular clearances are maintained, and that maximum pressure is relatively insensitive to total fluid volume. In addition, bottom chamber volume has little effect on maximum pressure, and mere variation in fluid volume cannot appreciably increase the maximum thrust level of the fatigue facility. E.A.O.

N66-31658# Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.

DESCRIPTION AND CAPABILITIES OF THE DOUGLAS BALLISTIC RANGES

R. N. Teng, R. C. Curtis, and J. R. Mastandrea 12 Apr. 1966 45 p refs
(SM-49090)

The ballistic range is described and its operational capabilities are discussed. It has been in operation since 1962 and is currently capable of launching models at speeds up to 30,000 fps in controlled atmospheres at pressures from 3 torr to 150 psia. Four different launchers are presently available. They include rifle propellant launchers with 0.30- and 3.5-inch diameters; a 1.5-inch diameter, single-stage light-gas gun, and a two-stage light-gas gun capable of using barrels between 0.25- and 0.80-inch in diameter. Another 0.50-inch diameter, high performance, two-stage light-gas gun is currently under construction and its expected performance has been included. Author

N66-31805# Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati.

RADIO FREQUENCY SYSTEM OF THE MICROTRON [IL SISTEMA DI RADIO FREQUENZA DEL MICROTRONE]

U. Bizzarri and A. Vignati 28 Dec. 1965 8 p refs In ITALIAN *Its* Note No. 301
(LNF-65/50)

A microtron model with a maximum energy of 4.5 MeV and a pulse current intensity of 0.5 mamp was developed at Frascati National Laboratory. The technical problems encountered and resolved in the dimensioning of the *r–f* system and of the resonance cavity of the microtron are described. The *r–f* system is described. The principal defects of the system consist of the cold emission and fluctuation in intensity with consequent fluctuations in the intensity of the accelerated beam. The introduction of an injector thermocathode will increase by a factor of 50 the intensity of the machine and improve the stability. NSA

N66-31842# Institut Franco-Allemand de Recherches, St. Louis (France).

DESCRIPTION AND POSSIBILITIES OF A 20 mm LIGHT GAS CANNON AND ITS APPROPRIATE HYPERBALLISTIC FIRING TUNNEL [DESCRIPTION ET POSSIBILITES DU CANON A GAZ LEGER DE 20 mm ET DU TUNNEL DE TIR HYPERBALISTIQUE CORRESPONDANT]

C. Lecomte 31 Dec. 1965 40 p refs In FRENCH
(ISL-T-51/65) CFSTI: HC $2.00/MF $0.50

Dimensions and performance data of a 20 mm light gas launcher and its hyperballistic firing tunnel are described. New features are a rapid-closing valve at the exit of the expansion chamber and a large-caliber container for microwave investigations. Velocities of 8000 m/s have been attained with polyethylene cylinders, and 5000 m/s with steel-tipped light metal alloy projectiles with conical aft. Hydrogen was used as a propellant gas, and no problems were encountered during firing in air. Transl. by K.W.

N66-32071*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

THE MERCURY-XENON ARC AND THE CARBON ARC AS SOURCES OF SOLAR SIMULATION

M. P. Thekaekara *In its* Publ. of Goddard Space Flight Center, 1963, Vol. II [1963] p 791–798 (See N66-32044 18-31) CFSTI: HC $7.00/MF $5.00

A critical analysis has been made of the problems of solar simulation in testing thermal balance of spacecraft. In particular, the spectral energy distributions of the mercury-xenon arc and the carbon arc have been compared to that of solar radiation in outer space. The results of previous investigators have been analyzed. A technique has been developed for precision measurement of intensity, using a high dispersion Jarrell–Ash grating spectrograph, and also two compact prism spectrographs, a Leiss and a Perkin-Elmer. The variability of both total energy and spectral distribution with discharge conditions has been investigated experimentally and theoretically. Author

N66-32102# ARO, Inc., Arnold Air Force Station, Tenn.

CALIBRATION OF THE SHOCK TUNNEL COMPONENT OF COUNTERFLOW RANGE (I) AT MACH 7.5

J. H. Haun and Henry W. Ball Arnold Eng. Develop. Center, May 1966 31 p refs
(Contract AF 40(600)-1200)
(AEDC-TR-66-64; AD-632816) CFSTI: HC $2.00/MF $0.50

Calibration of the shock tunnel component of the Counterflow Range (I) operating with a new nozzle throat designed to yield Mach 7.5 is reported. Transverse pitot-pressure profiles and heat-transfer rates on a hemisphere-cylinder model in the test section were measured at four flow conditions. A single probe was transversed along the nozzle centerline to determine the streamwise pitot-pressure gradient. Shock detachment distances for a hemisphere–cylinder were measured to determine when helium from the shock tunnel driver entered the test section. Results from these tests indicate a repeatable test core of uniform flow having a 12.5–in. diameter. Test times of from 2.5 to 4 msec were recorded before large quantities of helium appeared to be entering the test section. The streamwise pressure measurements indicated a Mach number gradient of 0.2/ft. Author (TAB)

N66-32128# Federal Aviation Agency, Atlantic City, N. J. Test and Evaluation Div.

IMPROVED EQUIPMENT ARRANGEMENTS FOR TRACON ROOMS Final Report

J. Roy Bradley, Jr. Apr. 1966 85 p
(RD-66-22)

This report presents the results of a research project conducted to recommend environmental and hardware improvements for Terminal Radar Control (TRACON) Rooms. Through the use of laboratory techniques a simulated TRACON room was established to test environmental concepts and equipments. Field controllers' opinions and recommendations, with those of the project members, were used as a basis for determining the advantages or disadvantages of particular equipments, their locations, and console modifications and configurations. Recommendations include: Operating position arrangement concepts; placement of auxiliary equipment and controls; improved lighting techniques and information display devices; and a new design for ATC TRACON room consoles. Author

N66-32169# France. Office National d'Etudes et de Recherches Aerospatiales, Chatillon-sous-Bagneux.

CATALOG OF NOTES ON THE ACTIVITY OF O.N.E.R.A., 1965 [RECUEIL DE NOTES SUR L'ACTIVITE DE L'O.N.E.R.A., 1965]

[1965] 105 p refs In FRENCH; ENGLISH summary
CFSTI: HC $3.00/MF $0.75

Technical notes and abstracts are presented on: aerodynamics, physics, propulsion systems, wind tunnel, resistance, material testing, and related topics. The following subjects are discussed: supersonic flow, Langmuir probe, hypersonic flight, spacecraft nozzles, hypersonic laminar atmosphere, ideal gas, flow distribution, aircraft stability, high altitude flight simulation, supersonic combustion, solar energy propulsion, deformation, chemical analyses, degradation, spectrographic analysis, noise attenuation, behavior of metallics, vibration modes, atmospheric turbulence, flow in turboreactors, rain erosion, refractory materials, lithergolic propellants, solar radiation, and meteorological instruments.
Transl. by R.LI.

N66-32209# Florida Univ., Gainesville. Florida Engineering and Industrial Experiment Station.

PROCEEDINGS OF THE FIFTEENTH ANNUAL AIR-CONDITIONING CONFERENCE Bulletin No. 123

Jun. 1966 111 p refs Conf. held 24–25 Feb. 1966 *Its* Eng. Progr., Vol. 20, No. 6

CONTENTS:

1. DESIGN OF CONTROL SYSTEMS Samuel P. Goethe (Ebaugh and Goethe) p 5–20 refs
2. PUMP SELECTION George A. Israel, Jr. (George A. Israel, Jr., Co.) p 21–33 ref
3. HEAT RECOVERY WATER HEATING T. L. Wetherington, Jr. (Fla. Power Corp.) p 34–48
4. USE OF COMPUTERS FOR DESIGN AND FOR ESTIMATING ENERGY REQUIREMENTS C. A. Morrison p 49–55 refs
5. SOME OBSERVATIONS ON AIR CONDITIONING FOR MULTIROOM BUILDINGS Herbert L. Laube p 56–62
6. WHAT HAPPENS TO THE NOISE CONTROL PROBLEM WHEN THE FAN STARTS? Herman Seelbach (Industrial Acoustics Co.) p 63–67
7. HARNESS THE ENERGY WITHIN THE BUILDING Robert B. Darling (Barber-Colman Co.) p 68–71
8. RECENT TRENDS IN SCHOOL AIR CONDITIONING Allen S. Russell (Lennox Ind. Corp.) p 72–78
9. PROBLEMS IN HOSPITAL AIR CONDITIONING Henry R. Hinkley p 79–85
10. TOUR THROUGH THE VETERANS ADMINISTRATION HOSPITAL, GAINESVILLE, FLORIDA Joseph Carbone (Syska and Hennessy) p 86–92

N66-32240*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

THE AMES WIND-TUNNEL GUST GENERATOR

Donald A. Buell *In* NASA. Langley Res. Center Meeting on Ground Wind Load Probl. in Relation to Launch Vehicles [1966] 6 p (See N66-32226 18-32) CFSTI: HC $5.29/MF $2.25

Research efforts toward the development of a gust generator, for use in a wind tunnel capable of high Reynolds numbers to study the effects of ground wind loads, is reviewed. The vortex-shedding forces, frequency distribution of atmospheric turbulence, and vehicle response spectrum are discussed. Gusts will be created by placing oscillating vanes upstream of the model. N.E.N.

N66-32241*# Texas A&M Univ., College Station. Dept. of Aerospace Engineering.

USE OF AIR INJECTION IN THE SIMULATION OF ATMOSPHERIC PROCESSES

Richard E. Thomas *In* NASA. Langley Res. Center Meeting on Ground Wind Load Probl. in Relation to Launch Vehicles [1966] 6 p (See N66-32226 18-32) CFSTI: HC $5.29/MF $2.25

Plans of the initial tests of the air injection of a 7×9 ft low speed wind tunnel are summarized. The ejector nozzles are mounted at the downstream end of the test section. The methods of obtaining sinusoidal gusts, random turbulence, and wind shears are mentioned. The results of a rough preliminary study are presented. N.E.N.

N66-32412# Politecnico di Milano. l'Instituto di Aeronautica.

THE AERONAUTICAL INSTITUTE OF THE POLITECHNICO DI MILANO [L'INSTITUTO DI AERONAUTICA DEL POLITECNICO DI MILANO]

1964 17 p refs In ITALIAN
(Publ.-71) CFSTI: HC $1.00/MF $0.50

Facilities and activities of the Aeronautical Institute at the Politecnico at Milan are reviewed. Historical development of the institute is treated from its beginnings in 1909 until the present time; and accomplishments are discussed in

very general terms. Attention is given to the physical set-up, including the various experimental laboratories; and mention is made of researches relating to practical aerodynamics, gas dynamics, mathematical physics, fluid mechanics and dynamics, and propulsion. Transl. by M.W.R.

N66-32417# Institut Franco-Allemand de Recherches, St. Louis (France).
THE PHOTOGRAPHIC INSTALLATION OF A CLASSIC FIRING TUNNEL [L'INSTALLATION PHOTOGRAPHIQUE DU TUNNEL DE TIR CLASSIQUE]
M. Giraud 10 Aug. 1965 66 p refs In FRENCH
(ISL-T-11/65) CFSTI: HC $2.50/MF $0.75

The photographic set-up of a classic firing tunnel is described, including an overall view of the tunnel, the launching of models, and the various measuring devices and camera. Method of restitution of the coordinates for the center of gravity of a projectile is discussed, and an example is given of the firing of a duralumin sphere with a speed of approximately 380 m/s. Attention is given to precision of measurements, and to the estimation of errors that might occur. The photographic installation is found to function effectively with spheres of diameters up to 30 mm. Transl. by M.W.R.

N66-32459# Cambridge Electron Accelerator, Mass.
INVESTIGATION OF EXPLOSION AND FIRE: EXPERIMENTAL HALL, CAMBRIDGE ELECTRON ACCELERATOR, CAMBRIDGE, MASSACHUSETTS, JULY 5, 1965
New York, AEC, Feb. 1966 87 p
(Contract AT(30-1)-2076)
(TID-22594) GPO: $0.60

An explosion and fire occurred at the Cambridge Electron Accelerator at 3:32 a.m. on July 5, 1965, resulting in the injury of 8 persons working in the Experimental Hall and the subsequent death of one of them. The cause of the explosion was not immediately determined but a large quantity of liquid hydrogen and liquefied petroleum gas had been present in the building. Damage to the structure and equipment was estimated at about $1,500,000. Results are reported from an investigation of the explosion and fire. NSA

N66-32484# Bureau of Mines, Albany, Oreg. Albany Metallurgy Research Center.
METALLURGICAL PROGRESS REPORT NUMBER 30, JANUARY 1–MARCH 31, 1966
Mar. 1966 20 p
(Contract AT(11-1)-599)
(USBM-RC-1232) CFSTI: HC $2.00/MF $0.50

The newly designed spin-casting arc furnace for high melting-point carbides is now in operation. Trial runs show considerable versatility and freedom of adjustment of variables. The effects of thoria additions on the tensile properties of thorium in the temperature range 400 to 800°C were investigated. Additions of up to 5% thoria made no significant change in the tensile properties. Metallography, density, and alloy content data were obtained for each W–Re–Mo sleeve. Impurity analyses were recently made of several samples to characterize the sleeves made this fiscal year. Recovery of the rhenium from scrap was started. Extruded bars of W–25Re were fully conditioned to stock suitable for sheet rolling. Heavy metal losses were encountered, especially in the powder-processed alloy. NSA

N66-32625# Boeing Co., Renton, Wash. Airplane Div.
367-80 VARIABLE STABILITY SIMULATION SYSTEM (NASA AMES LARGE TRANSPORT SIMULATION PROGRAM)
G. W. Baska and R. E. Robbins [1966] 183 p refs
(Contract NAS2-3224)
(NASA-CR-62037; D6-19860) CFSTI: HC $3.25/MF $1.25
CSCL 14B

Described are techniques, hardware, operational procedures, and the various configurations simulated by a modified Boeing 707 airplane in a study on in-flight dynamics of very large transport airplanes with emphasis on the approach and landing phases of flights. Configurations simulated were based on control and stability derivatives of very large four engine, subsonic transport jets. In addition, a number of variations in lateral directional and longitudinal axes characteristics were also simulated. Results are contained in numerous tables. G.G.

12 FLUID MECHANICS

Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion.

N66-31507# Colorado State Univ., Fort Collins. Coll. of Engineering.
FLUID MECHANICS PROGRAM: FLUID DYNAMICS AND DIFFUSION LABORATORY
Jan. 1966 42 p refs
(AD-633017) CFSTI: HC $2.00/MF $0.50

A brochure which is devoted to a description of the facilities, research activities, and personnel associated with the fluid dynamics and diffusion laboratory of the Colorado State University is presented. The laboratory facilities and instrumentations discussed include a meteorological wind tunnel, a low speed wind tunnel, a jet facility, ion beam facilities, electrokinetics facilities, and a shock tube. Research studies and reports are given for basic mechanics of fluids, geophysical fluid mechanics, and the physics of fluids. C.T.C.

N66-31553# Sandia Corp., Albuquerque, N. Mex.
SHOCK TESTING WITH HIGH EXPLOSIVE INITIATED GAS DETONATIONS
W. M. Sigmon, Jr. *In* NRL The Shock and Vibration Bull. No. 35, Pt. 6 Apr. 1966 p 69–82 refs Sponsored by AEC
(See N66-31546 18-32) CFSTI: HC $7.00/MF $1.75

The development is described of a simple, convenient method of controlling pulse rise times in explosive gas tests. The pulse rise time on a test item subjected to an explosive pressure loading is a function of the rate or velocity at which the shock wave sweeps over the affected surface. The sweep velocity is, in turn, a function of the angle at which the shock wave meets the test item surface. Author

N66-31554# New Mexico Univ., Albuquerque.
A METHOD OF PRODUCING LONG-DURATION AIR-INDUCED GROUND SHOCK USING HIGH EXPLOSIVES
Eugene Zwoyer, George Triandafilidis, and James Stras *In* NRL The Shock and Vibration Bull. No. 35, Pt. 6 Apr. 1966 p 83–104 refs Sponsored by AF (See N66-31546 18-32)
CFSTI: HC $7.00/MF $1.75

Simulation of the effects of a nuclear weapon using the Long-Duration High-Explosives Simulation Technique (LDHEST) is described. The principal objectives of LDHEST are: (a) to produce a predictable peak pressure on the bottom surface of an underground cavity; (b) to produce a predictable exponential decay in pressure with time; and (c) to cause the generated shock front to move across the bottom of the cavity with predictable velocity. Author

N66-31635# AVCO Corp., Wilmington, Mass. Research and Advanced Development Div.
SOLUTION OF LAMINAR COMPRESSIBLE BOUNDARY LAYER WITH DISCRETE INJECTION (FOR AIR IN CHEMICAL EQUILIBRIUM)
A. Pallone *In its* Thermal Protect. Systems Jan. 1965 p 633-639 ref (See N66-31626 18-33) CFSTI: HC $9.80/MF $3.00

Basic equations describing the boundary-layer flow for dissociated air in chemical equilibrium, over two-dimensional or axisymmetrical bodies, together with a heat-balance relation formula, were utilized to find analytic expressions for the energy balance and matching conditions of injected gaseous boundary layers. A computer program is being constructed for solving the evolved system of equations. G.G.

N66-31636# AVCO Corp., Wilmington, Mass. Research and Advanced Development Div.
THE STAGNATION POINT FLOW OF NON-EQUILIBRIUM AIR, WITH AND WITHOUT INJECTION
A. Pallone *In its* Thermal Protect. Systems Jan. 1965 p 641-663 refs (See N66-31626 18-33) CFSTI: HC $9.80/MF $3.00

This appendix, the laminar boundary layer flow of dissociated air in chemical non-equilibrium is studied at the stagnation point. The influence of injecting a variety of foreign gas is also investigated. The air is treated as a mixture of five components (O, O_2, N, N_2, NO) with the molecular internal degrees of freedom in equilibrium with the translational mode. The best presently available reaction rates for the pertinent gas phase reactions are employed. A new set of transport and thermodynamic properties is utilized. The analysis is restricted to temperatures below 8000°K. The equations expressing conservation of chemical species, energy, and momentum are transformed to a set of linear ordinary differential equations which may be solved by an iteration procedure on an automatic digital computer. Author

N66-31648# North American Aviation, Inc., El Segundo, Calif. Ocean Systems Dept.
BOUNDARY LAYER STUDIES—PRACTICAL IMPLICATIONS
E. R. van Driest *In* Office of Aerospace Res. Proc. of the OAR Res. Appl. Conf. [1966] p 11-28 refs (See N66-31646 18-34) CFSTI: HC $5.00/MF $1.00

Research on viscous flow phenomena, with emphasis on the mechanism and control of transition from laminar to turbulent flow is reported. Relationships have been derived that give the size of finite roughness elements required to generate a fully turbulent flow depending on Mach number and heating rate, and that indicate the effect of intensity of free stream turbulence and amount of pressure gradient on transition. A discussion is included of how this control of boundary layer transition can influence the design of high-lift STOL aircraft as well as hypersonic reentry vehicles. C.T.C.

N66-31663# Aix-Marseilles Univ. (France). Institut de Mecanique Statistique de la Turbulence.
ANNUAL SUMMARY REPORT NO. II
Jan. 1966 40 p refs
(Contract AF 61(052)-772)
(AFOSR-66-0614; AD-630629) CFSTI: HC $4.60/MF $0.50

CONTENTS:
1. MACROSCOPIC EULERIAN DERIVATIVE OF A VOLUME INTEGRAL. ENTROPY OF A TURBULENT GAS A. J. Favre p 2-11 refs (See N66-31664 18-12)
2. SOME SPECTRAL MEASUREMENTS OF SPACE-TIME CORRELATIONS A. J. Favre, R. Dumas, and E. Verollet p 12-40 refs (See N66-31665 18-12)

N66-31664# Aix-Marseilles Univ. (France). Institut de Mecanique Statistique de la Turbulence.
MACROSCOPIC EULERIAN DERIVATIVE OF A VOLUME INTEGRAL. ENTROPY OF A TURBULENT GAS
A. J. Favre *In its* Ann. Sum. Rept. No. II Jan. 1966 p 2-11 refs (See N66-31663 18-12) CFSTI: HC $4.60/MF $0.50

A macroscopic eulerian derivation of a volume integral for compressible turbulent gases is presented. The development of a statistical equation of entropy for a turbulent gas moving at macroscopic velocities is included. C.T.C.

N66-31665# Aix-Marseilles Univ. (France). Institut de Mecanique Statistique de la Turbulence.
SOME SPECTRAL MEASUREMENTS OF SPACE-TIME CORRELATIONS
A. J. Favre, R. Dumas, and E. Verollet *In its* Ann. Sum. Rept. No. II Jan. 1966 p 12-40 refs (See N66-31663 18-12) CFSTI: HC $4.60/MF $0.50

Measurements of space-time correlation spectra for velocities in a turbulent boundary layer with longitudinal and transversal displacement are presented. It is shown that the maximum maximorim correlation is decreasing when the frequency is increasing, although its location is only slightly affected by the frequency. Space-time correlation measurements are extended to thermal fluctuations, and a heated plate is designed for this purpose. C.T.C.

N66-31774# European Atomic Energy Community, Brussels (Belgium).
CONVERSION OF LEAK FLOW-RATES FOR VARIOUS FLUIDS AND DIFFERENT PRESSURE CONDITIONS
J. Amesz 1966 37 p refs
(EUR-2982.e) CFSTI: HC $2.00/MF $0.50

This report contains in a concise form the development of rules for conversion of gas and liquid leakages. In many cases, for reasons of convenience, leaktightness of components is tested by means of a gaseous medium, although they actually operate with a liquid medium. As leak mechanisms of a liquid and a gas are often principally different, conversion requires the application of appropriate correlations. Based on theoretical considerations, such correlations are derived and presented in this paper. Author

N66-31837# Witwatersrand Univ., Johannesburg (South Africa). Dept. of Mechanical Engineering.
PROFILES OF DIFFRACTING SHOCK WAVES: AN ANALYSIS BASED ON WHITHAM'S THEORY
B. W. Skews Apr. 1966 61 p refs
(Rept.-35) CFSTI: HC $2.50/MF $0.75

In this report the two-dimensional diffraction of shock waves is considered. The analysis is based on the theory presented by Whitham (1957) for the interaction of an originally plane shock with a corner. A method is presented whereby the shock profile may be determined for a wall of any shape and for any incident shock Mach number in regions where the characteristics form a simple wave. Exact solutions are found for the shape of a shock diffracting on plane walled convex corners and are compared with Whitham's strong shock solution. Solutions are also presented for circular arc convex and concave walls and an arbitrary convex corner. The strong shock solution for the circular arc convex wall is included. Author

N66-31869# Institut Franco-Allemand de Recherches, St. Louis (France).
DIMINUTION OF SHOCK WAVES IN SUBTERRANEAN WIND TUNNELS. EXPANSION CHAMBER AND WALL REVETMENT [DEGRADATION DES ONDES DE CHOC DANS LES GALERIES SOUTERRAINES. CHAMBRE D'EXPANSION ET REVETEMENT DE PAROIS]
C. Thery and Ch. Rothea-Laurent 8 Dec. 1965 43 p In FRENCH
(ISL-T-30/65) CFSTI: HC $2.00/MF $0.50

The degrading effects on shock waves of teeth protruding into the wind tunnel, recessions in the tunnel wall, local enlargements, and combinations of these were investigated. The results are presented in the form of shadowgrams and interferograms. It is noted that the best results were obtained with the local expansions. Transl. by D.T.

N66-31879# National Aerospace Lab., Tokyo (Japan).
AN APPROXIMATE CALCULATION FOR SUPERSONIC FLOW PAST BODIES OF ROCKET VEHICLES. II: LINEARIZED FLOW WITH ATTACK ANGLE
Takashi Tani 1966 22 p refs In JAPANESE; ENGLISH summary
(NAL-TR-102) CFSTI: HC $1.00/MF $0.50

In a previous report, the author transformed the equation for axisymmetric linearized supersonic flow to the two-dimensional equation in the vicinity of the body surface. In this report he applies similar transformation for the cross flow equation. The normal force distribution can then be easily calculated at the downstream of the sharp corner. For example, the normal force on boattail, flare, and cylindrical afterbody of a cone cylinder is treated. Author

N66-31883# National Aerospace Lab., Tokyo (Japan).
A THEORETICAL INVESTIGATION OF THE COMPRESSIBLE FLOW THROUGH THE AXIAL TURBO-MACHINES. FIRST REPORT: NON-SWIRLING FLUIDS IN DUCTS
Shoichi Fujii 1965 31 p refs In JAPANESE; ENGLISH summary
(NAL-TR-97) CFSTI: HC $2.00/MF $0.50

Making use of the actuator disk concept, the theoretical survey of the subsonic flows with special reference to both the compressibility and the hub contour was carried out. As the first report, outlined here is the basic theory for the compressible shear flows in ducts with varying hub radii. Numerical examples are presented and discussed briefly. It is concluded that within the realm of linear treatment the tangential vorticity component is flowing along the main stream and attenuated by the contraction of passages. Numerical results illustrate the marked difference between the converging and the diverging flows, especially in the axial velocity profiles. It also emphasizes that the radial flows occur strongly when flowing at high Mach-number level. The present theory applied for the cylindrical duct and the classical actuator disc theories have been compared and thereby the agreement has been proven in their mathematical forms, although the damping coefficient of our theory is a little smaller (about 10 per cent) than that of the classical one. Author

N66-31916# National Aerospace Lab., Tokyo (Japan).
A GENERALIZED FUNCTIONAL FORMALISM FOR TURBULENCE
Iwao Hosokawa Dec. 1965 14 p refs
(NAL-TR-96T) CFSTI: HC $1.00/MF $0.50

The functional formalism for turbulence mechanics originated with Hopf is generalized in a similar way to Lewis and Kraichnan's published in 1962. The theory developed here is, however, more compact and general than theirs and contains a deduction of a general solution of the full basic functional equations in terms of functional integrations. Hopf's theory is reproduced by a specialization of the function space. When all of the dynamical equations governing turbulent fields are given linear, the solution for our generalized characteristic functional is expressed in quite a simple form. Author

N66-31961# Canterbury Univ., Christchurch (New Zealand).
HAND METHOD FOR TURBULENT PIPE FLOW PROBLEMS
K. M. Yao [1965] 11 p refs Presented at the 2d Australasian Conf. on Hydraulics and Fluid Mech., Nov. 1965
CFSTI: HC $1.00/MF $0.50

A hand method is suggested for solving turbulent pipe flow problems using the Darcy equation without the need of any of the special tools such as the Moody diagram. Briefly, the method is to arrange the complex equation involved in solving a turbulent pipe flow problem into a standard pattern and to apply an iterative procedure for its solution. The number of cycles required for results with deviations well within ±5% in most cases should be less than three. The method is applicable to all simple pipe problems as well as compound pipe problems such as pipes in series and parallel pipes. The method is also adaptable to digital computer programming. The applicable range of the relatively roughness is from 0 to 0.1 and that of the Reynolds number from 4,000 up to any high value. Author

N66-31974# Boeing Scientific Research Labs., Seattle, Wash.
FLIGHT SCIENCES LABORATORY REVIEW, JULY-DECEMBER 1965
[1965] 144 p refs

Continuing research in related areas of flight science is briefly summarized. Behavior of a slow speed jet from a hovering helicopter rotor after impingement on the ground is discussed. Continuing investigations are reported on the aerodynamic aspects of boundary layer control by means of tangential blowing, as well as studies for improving the solution for maximum lift coefficient. Current studies in boundary layer stability, flow over a flexible wall, the effect of upstream velocity profile on the mixing of jets, vortex flow, and higher approximations to the axisymmetrical viscous wake solution are mentioned. Determination of directional sensitivity of hot-wire anemometers is discussed, and the viscous flow of stratified fluids past a cylinder is illustrated. Other areas under

examination include: the wave resistance of a ship, solutions of hydrodynamic boundary value problems, combustion in supersonic flow, shock-on-shock interaction, an exploding-wire process, and collision-radiative recombination in an alkali plasma. S.P.

N66-31975# Melpar, Inc., Falls Church, Va.
ACCELERATED BOUNDARY LAYER OVER A SLENDER CIRCULAR CYLINDER
Jan Raat 12 May 1966 74 p refs

The simultaneous effect of unsteadiness and boundary layer transverse curvature is investigated for slender bodies of revolution, in particular, a cylinder. The time-dependent boundary layer equations are analyzed by means of regular perturbation techniques, for the case of accelerated motion from rest. Solutions are obtained for weak and for strong transverse curvature, respectively. In the intermediate regime, where the curvature is neither weak nor strong, the solution has been estimated by graphical interpolation. The numerical results indicate that the relative increase in skin friction (compared to the quasi-steady value) due to the effect of unsteadiness, is gradually suppressed as the transverse curvature of the boundary layer becomes more pronounced. It is shown that the Oseen method of analyzing viscous flow fields has quantitative value for accelerated boundary layers with strong transverse curvature. Author

N66-31985# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
ON THE INFLUENCE OF THE INTERACTION OF VISCOUS AND INVISCID STREAMS ON THE FLOW IN THE BASE REGION OF A BODY MOVING AT HYPERSONIC VELOCITIES [O VLIYANII VZAIMODEISTVIYA DISSIPATIVNOVO I IZENTROPICHESKOVO POTOKOV NA TECHENIE V DONNOI OBLASTI TEL, DVIZHUSHCHIKHSYA S GIPERZVUKOVOI SKOROST'YU]
L. I. Myshkova Jun. 1966 21 p refs Transl. into ENGLISH from Vestn. Leningr. Univ. (Leningrad), v. 19, 1965 (TR-33)

The interaction between the region of mixing and the outer potential flow of a body moving at hypersonic velocities is investigated. It is assumed that weak interaction occurs in the base region of the body. The transfer equations of mass, momentum, and energy in the mixing zone are stated. An expression for pressure obtained from the Prandtl–Meyer flow is used for determining the coefficients of expansion. Equations are given for determining the velocity and temperature profiles in the mixing zones. K.W.

N66-31986# Instituto de Investigacion Aeronautica y Espacial, Cordoba (Argentina).
A STUDY OF SEPARATED BASE FLOW BEHIND BODIES OF REVOLUTION IN SUPERSONIC STREAMS. PART II: SOME EXTENSIONS OF CROCCO–LEE'S THEORY APPLIED TO BIDIMENSIONAL AND AXIALLY SYMMETRICAL FLOW
Joseph Stanislas de Krasinski Jan. 1966 42 p refs
(IIAE-INF-01-66, Pt. II) CFSTI: HC $2.00/MF $0.50

The Crocco–Lees theory has been extended to obtain the universal parameter F used in the incompressible plane from measurements in the compressible flow. Also, an extension has been made to apply the theory for the axially symmetrical case. Author

N66-31987# Instituto de Investigacion Aeronautica y Espacial, Cordoba (Argentina).
A STUDY OF SEPARATED BASE FLOW BEHIND BODIES OF REVOLUTION IN SUPERSONIC STREAMS. PART III: EXPERIMENTAL TECHNIQUES EMPLOYED IN THE MEASUREMENTS OF THE AXIALLY SYMMETRICAL BASE FLOW
Joseph Stanislas de Krasinski Apr. 1966 46 p refs
(IIAE-INF-01-66, Pt. III) CFSTI: HC $2.00/MF $0.50

A detailed description is given of the method of measurement used during the tests, stressing the importance of the experimental techniques on the results. Methods have been developed which contributed substantially to the consistency of the measured data. Author

N66-31990# Instituto de Investigacion Aeronautica y Espacial, Cordoba (Argentina).
A STUDY OF SEPARATED BASE FLOW BEHIND BODIES OF REVOLUTION IN SUPERSONIC STREAMS. PART I: REVIEW OF PHYSICAL AND THEORETICAL ASPECTS OF BASE FLOW
Joseph Stanislas de Krasinski Jun. 1965 162 p refs
(IIAE-INF-01-65, Pt. I) CFSTI: HC $3.25/MF $1.00

Physical and mathematical aspects of base flow are critically surveyed. Particular attention is given to the dividing streamline and Crocco–Lees theories. Attention is also drawn to the inconsistencies in the observed data and the leading theories. Author

N66-32103# Bureau of Ships, Washington, D. C.
LIFTING LINE THEORY OF A HYDROFOIL OF ARBITRARY SHAPE MOVING IN SHALLOW WATER [TEORIIA NESUSHCHEII LINII PODVODNOGO KRYLA PROIZBOL'NOI FORMY NA MELKOVOD'YE]
G. A. Goshev Jan. 1966 13 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Otd. Tekhn. Nauki Mekhan. i Mashinostr. (Moscow), no. 3, 1964 p 29–38 *Its* Transl.-966 (TT-66-61221; AD-632460) CFSTI: HC $1.00/MF $0.50

The report contains the solution of the space problem of even movement of an underwater wing of finite dimension in shallow water. The shape of the wing in a plane which is perpendicular to the movement, and its disposition in relation to the free surface are assumed to be arbitrary. Used as the basis of the solution were the lifting line theory of Prandtl and linear limit conditions on a free surface. Author (TAB)

N66-32107*# Southwest Research Inst., San Antonio, Tex.
AN EXPERIMENTAL STUDY OF LIQUID SURFACE OSCILLATIONS IN LONGITUDINALLY EXCITED COMPARTMENTED CYLINDRICAL AND SPHERICAL TANKS
Daniel D. Kana Washington, NASA, Aug. 1966 26 p refs
(Contract NAS8-11045)
(NASA-CR-545) CFSTI: HC $1.00/MF $0.50 CSCL 20D

An experimental investigation of liquid surface oscillations has been conducted for liquid propellants in longitudinally excited, rigid, 90° sector cylindrical, and spherical tanks. It is determined that for longitudinal excitation, propellant motions in these tanks are basically a nonlinear 1/2 subharmonic surface motion in some predominant mode, similar to the general liquid behavior that has earlier been found to occur in a rigid cylindrical tank. However, in the case of the 90° sector tank it is found that the surface shape of the predominant mode is different from that of the corresponding mode for lateral translational excitation. Stability boundaries, as well as liquid response curves are presented for two modes under various excitation conditions in each tank. Author

N66-32190*# McGill Univ., Montreal (Quebec). Space Research Inst.
A FINITE DIFFERENCE SOLUTION FOR THE TWO-DIMENSIONAL EXPANSION OF A FINITE CYLINDRICAL GAS CLOUD INTO A VACUUM
G. G. Bach and J. H. S. Lee Apr. 1966 66 p refs
(Contract NAS3-4190)
(NASA-CR-54726; SRI-I-TN-3) CFSTI: HC $2.50/MF $0.75
CSCL 20D

The interaction of radial and axial rarefaction waves has been investigated by considering the expansion of a finite length cylindrical gas cloud into a vacuum. A numerical finite difference scheme was used for the integration of the basic conservation equations of gas dynamics. A toral co-ordinate system was developed for the solution of the flow in the corner regions of the cylinder. A perfect gas with $\delta=3$ was assumed and numerical results are given for three cases of radius to half length ratios greater than, equal to and less than unity. In spite of the simplicity of the physical model studied, experimental observations such as cloud shapes and the identations made on witness plates downstream of the bumper are predicted by the present results. Author

N66-32194# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).
ON THE THEORY OF CLASSICAL FLUID VI
L. Verlet and D. Levesque Apr. 1966 29 p refs
(TH/109) CFSTI: HC $2.00/MF $0.50

An equation generalizing the Percus–Yevick equation for classical fluids is studied in detail. Approximate integral equations for the correlation function of classical fluids—the PY and HNC equations—are derived using the Percus functional derivative technique. The PY II equation, which is the one obtained when the first correction term to the PY equation is included, is first solved in the case of the hard-sphere gas where results coming from three sources are known: molecular dynamics, Monte Carlo calculations, six-term varial series with Pade approximants. It was demonstrated that the PY II equation is a valid second approximation to the PY approximation, and is considered to be a reliable tool to calculate the critical constants, once the interaction is known. R.L.I.

N66-32199# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
POISEVILLE FLOWS WITH BOUNDARY DISTURBANCES
V. O'Brien Mar. 1966 41 p refs
(Contract NOw-62-0604-c)
(TG814; AD-633007) CFSTI: HC $2.00/MF $0.50

Direct numerical solutions were obtained for steady Stokes flow in planar and axisymmetric channels with boundary disturbances. The flows with the disturbances considered, straightsided grooves in the wall or projections into the channel of various height to length ratio, show interesting (separated) recirculation regions. Author (TAB)

N66-32213# General Electric Co., Schenectady, N. Y. Research and Development Center.
LAMINAR CONE BOUNDARY LAYER TRANSITION, M_1= 10.2 TO 13.8
H. T. Nagamatsu, B. C. Graber, and R. E. Sheer, Jr. Oct. 1965 55 p refs Sponsored in part by AF
(Rept.-65-C-005; AD-478156)

An investigation was conducted in a hypersonic shock tunnel to study the laminar boundary layer transition on a 10° cone of 4-foot length with a wall to stagnation temperature ratio of 0.214. The stagnation temperature was held approximately constant at 1400°K while the free-stream Mach number range over the surface heat transfer gauges was from 10.2 to 13.8. The effects on transition of Mach number, surface roughness, and ±2° angle of attack were investigated. Fast response surface heat transfer gauges were used to detect the beginning of transition. Boundary layer pitot surveys were made to verify the interpretation of the heat transfer data. It was found that surface roughness promoted boundary layer transition with the transition Reynolds number being related to the amount of surface roughness as would be expected. The local skin friction data, determined from the pitot tube surveys, agreed quite well with the heat transfer data when compared through the modified Reynolds analogy. The angle of attack data indicated the cross flow to have a strong influence on transition by promoting it on the sheltered side of the cone and possibly delaying it on the windward side. Author (TAB)

N66-32224# Purdue Univ., Lafayette, Ind.
ON THE CONVERGENCE AND EXACTNESS OF SOLUTIONS OF THE LAMINAR BOUNDARY-LAYER EQUATIONS USING THE N-PARAMETER INTEGRAL FORMULATION OF GALERKIN–KANTOROVICH–DORODNITSYN
Howard E. Bethel (Ph.D. Thesis) Jun. 1966 285 p refs
(Contract AF 33(608)-1270)
(AD-633199) CFSTI: HC $6.00/MF $1.50

The solution of the incompressible, laminar boundary-layer equations using the N-parameter integral method of Galerkin, Kantorovich and Dorodnitsyn is investigated. This method seeks to obtain an approximate solution of a partial differential equation with given boundary conditions by assuming the solution in functional form so that the boundary conditions for one variable are exactly satisfied. The approximating function is then specialized in such a manner as to obtain approximate satisfaction of the given equation. Solutions are presented for the similar flows and four types of nonsimilar flows: flows with an abrupt change from an initial region of flow to a constant velocity flow, analytically prescribed external flows, experimentally determined external flows, and flows which proceed from a stagnation point to a separation point. These results indicate that the GKD method yields solutions which are uniformly better than classical approximation techniques and are of about the same accuracy as the usual 'exact' numerical solution methods such as the series method, the Hartree–Womersley method and finite difference methods. Furthermore, solutions can be obtained as close to the separation point as computationally feasible. Author (TAB)

N66-32237*# Colorado State Univ., Fort Collins. Coll. of Engineering.
LABORATORY SIMULATION OF ATMOSPHERIC MOTIONS IN THE LOWEST ONE HUNDRED METERS
J. E. Cermak *in* NASA. Langley Res. Center Meeting on Ground Wind Load Probl. in Relation to Launch Vehicles [1966] 24 p refs (See N66-32226 18-32) CFSTI: HC $5.20/MF $2.25
(Grant DA-AMC-28-043-65-G20)

The simulation of motion in the atmospheric surface layer by low speed, wind tunnel flows is discussed. Similarity parameters and wind tunnel characteristics required for simulation of small- and micro-scale atmospheric motions are stated. Comparisons of vertical distributions of mean velocity for different thermal conditions, turbulence power spectra, energy

dissipation rates, and intensity of the vertical component of turbulence are made for wind tunnel and atmospheric data—data taken in the thick turbulent boundary layer (1 m) produced by flow over a long test-section floor (20 m) show good agreement with atmospheric data. Time and length scaling factors for small and large scale turbulence are established through the use of similarity agreements utilizing the energy dissipation rate per unit of mass. Author

N66-32242*# Northrop Corp., Newbury Park, Calif.
NUMERICAL SOLUTION OF THE EQUATIONS OF CONTINUUM MOTION: VORTEX FORMATION AND SHEDDING IN A VISCOUS COMPRESSIBLE FLUID
John G. Trulio *In* NASA. Langley Res. Center Meeting on Ground Wind Load Probl. in Relation to Launch Vehicles [1966] 19 p ref (See N66-32226 18-32) CFSTI: HC $5.29/MF $2.25

The numerical solution of the Navier–Stokes equation for the flow of a viscous compressible fluid around an infinite right circular cylinder is reviewed. Continuum motion problems solutions were adapted to the solution of aerodynamic problems. The essential principle involved is identified as that of momentum conservation, independently of whether the forces producing motion result from a gravitational field, shearing stresses in an elastic medium, or pressure in an ideal gas. Typical solutions are discussed for the time-marching or Lagrangian problem and for the Eulerian case. It was considered that the most interesting results related to the time-averaged drag on the cylinder. Detailed plots of the pressure distribution around the cylinder for Reynolds number=1000 showed point-to-point fluctuations. These results and their implications are discussed. N.E.N.

N66-32383# Deutsche Versuchsanstalt für Luft- und Raumfahrt, Aachen (West Germany). Institut fuer Theoretische Gasdynamik.
THE ASYMPTOTIC BEHAVIOR OF SPHERICAL AND CYLINDERSYMMETRICAL WAVES [DAS ASYMPTOTISCHE VERHALTEN VON KUGEL- UND ZYLINDERWELLEN]
Hermann Rothman May 1966 21 p refs In GERMAN; ENGLISH summary
(DLR-FB-66-38; DVL-516)

The asymptotic behavior of spherical and cylindrical waves has been studied. A method was applied by using the characteristical coordinates as independent variables. A perturbation procedure was made for flow quantities as well as for space and time coordinates, and first order terms were calculated. Long-time investigation shows that already the first order theory gives the correct asymptotic behavior of such waves. Author

N66-32389# Maryland Univ., College Park. Inst. for Fluid Dynamics and Applied Mathematics.
ON TIME-DEPENDENT BOUNDARY LAYERS
Jan Raat (Ph.D. Thesis) 1966 136 p refs

A theoretical analysis of some unsteady viscous flow fields was conducted. Cases of impulsive motion and uniform acceleration of an incompressible boundary layer flow over a semi-infinite flat plate are considered. By using a momentum-integral method with selected velocity profiles, meaningful solutions are obtained. The solutions have an essential singularity which moves along the plate with the external inviscid flow velocity. An accelerated boundary layer flow over a cylinder is examined. Perturbation methods are used to find solutions for weak and strong transverse curvature of the boundary layer. The numerical results indicate that the relative increase in skin friction due to the unsteadiness effect is gradually suppressed as the transverse curvature of the boundary layer becomes more pronounced. The Oseen method of analyzing viscous flow fields is shown to have a quantitative value for accelerated boundary layers with strong transverse curvature. The sound generation mechanism of a laminar unsteady viscous gas flow is studied. The flow fields of an infinite plate oscillating in its own plane and a circular cylinder oscillating parallel to its axis are analyzed. R.N.A.

N66-32442*# Ling-Temco-Vought, Inc., Dallas, Tex. Research Center.
STUDY OF VORTEX BOUNDARY LAYER INTERACTIONS Final Report, Period Ending 26 Jun. 1966
J. G. Spangler [1966] 20 p refs
(Contract NASw-956)
(NASA-CR-76772) CFSTI: HC $1.00/MF $0.50 CSCL 20D

This report describes the progress made during this period as well as the overall program results of a study conducted on the effects of strong persistent vortices on a turbulent boundary layer. The program objectives are presented and various aspects of the study are summarized including the experimental facility and instrumentation, the vortex-boundary layer interactions, and turbulent pipe flow at very low speeds. R.N.A.

N66-32512# Boeing Scientific Research Labs., Seattle, Wash. Flight Sciences Lab.
REGULAR DISTURBANCES IN THE TURBULENT BOUNDARY LAYER
J. D. Mc Clure Jan. 1965 56 p refs Sponsored in Part by AFOSR *(ts* Rept.-92
(D1-82-0397; AD-613569) CFSTI: HC $3.00/MF $0.75

A theory for traveling-wave disturbances in the fully turbulent boundary layer is developed on the basis of an analogy with laminar viscous flow. The point of view that the flow perturbations are induced by a prescribed wall disturbance is adopted, but the results are basic to studies of the stability of disturbances in a flexible wall and the adjoining flow. The analogy with the laminar flow, which is constructed by averaging over an ensemble of turbulent flows, is complete for the flow of an incompressible fluid over a wall that has no random component of deformation and holds for the first term of an iterative solution in the more general case. TAB

N66-32515# Polytechnic Inst. of Brooklyn, N. Y. Dept. of Aerospace Engineering and Applied Mechanics.
ON THE INTERACTION OF A TWO-DIMENSIONAL JET WITH A PARALLEL FLOW
Robert C. Ackerberg and Alexander Pal Sep. 1965 58 p refs
(Contract DA-44-177-AMC-91(T))
(PIBAL-889; AD-631873) CFSTI: HC $3.00/MF $0.75

The injection of a two-dimensional jet of total head H_1 from an infinite plate into a uniform stream of lower total head H_2 is considered, the fluids being assumed inviscid and incompressible. Steady, irrotational solutions of Euler's equations are found for H_1/H_2 approaching infinity. The region behind the jet is treated as a stagnant wake with constant pressure equal to that of the undisturbed stream, and the jet injection angle is fixed across the jet opening. When a thin jet approximation is combined with Bernoulli's principle, a non-linear boundary condition is derived along the vortex sheet separating the jet from the external flow. The resulting non-linear potential problem (in the plane of the

complex velocity potential) for the external flow is shown by Pai to be equivalent to a variational problem. A numerical procedure based on the variational principle and the Ritz–Galerkin method is used to solve for the case of normal injection with a digital computer. The pressure distribution along the plate upstream and streamline diagrams are given. Author (TAB)

N66-32524# Massachusetts Inst. of Tech., Cambridge, Mass. Gas Turbine Lab.

NON-EQUILIBRIUM CONDENSATION OF CARBON DIOXIDE IN SUPERSONIC NOZZLES

Karl M. Duff Jan. 1966 205 p refs

(Contract Nonr-3963(07))

(Rept.-84; AD-478063)

Experiments involving the condensation of CO_2 in three supersonic nozzles were conducted. Results indicate that moisture formation is not abrupt as in the case of pure water vapor, but is more gradual. The stream remains considerably super-saturated downstream of initial condensation. Rates of expansion, as determined by nozzle geometry, have a marked influence upon the degree of super-saturation obtained prior to condensation. Nucleation and drop growth theory, as applied in this study, will reasonably predict the conditions at onset of condensation provided small corrections to flat film liquid surface tension are applied. This correction amounts to an increase of between 17% and 38% in flat film liquid values, depending upon values of thermal and mass accommodation coefficients which are applied. Author (TAB)

N66-32552*# Case Inst. of Tech., Cleveland, Ohio. Engineering Div.

THE KELVIN–HELMHOLTZ INSTABILITY WITH ARBITRARILY ORIENTED BODY FORCE

Robert G. Hantman and Simon Ostrach (Thesis) Jun. 1966 102 p refs

(Grant NsG-391)

(NASA-CR-76798; FTAS/TR-66-11) CFSTI: HC $3.00/MF $0.75 CSCL 20D

This thesis is a study of the interfacial stability of two parallel superposed inviscid streams of fluid. The problem is a generalization of the Kelvin–Helmholtz model, with the new feature being the addition of a component of the body force tangential to the flow direction. The results are applied to the stability of the molten liquid–gas interface on an ablating re-entry body. Author

N66-32578# Northrop Corp., Hawthorne, Calif. Norair Div.

INTERACTION OF THE WAKE FROM SMALL BLUFF BODIES WITH AN INITIALLY LAMINAR BOUNDARY LAYER

G. R. Hall Aug. 1965 76 p refs

(NOR-65-205)

An experimental investigation was conducted to determine the mechanism and conditions which govern boundary layer transition induced by small bluff body elements immersed in an initially laminar boundary layer. The mechanism by which transition occurred was found to be a local effect of the direct introduction of turbulent fluid from the wake of the element below a critical value of y/δ within the boundary layer. Transition of the boundary layer at a given location was found to depend, to first approximation, solely upon the Reynolds number of the element and the depth of immersion in the boundary layer, y/δ. Transient conditions, three-dimensionality of the boundary layer, body interaction effects, and irregular body geometries, appeared as perturbations of the basic problem rather than sources of any grossly different flow phenomena which would serve to alter the turbulence production mechanism significantly. Author

N66-32598# Library of Congress, Washington, D. C. Aerospace Technology Div.

INTERACTION BETWEEN THE BOUNDARY LAYER AND THE HYPERSONIC FLOW IN A CONICAL NOZZLE [VZAIMODEYSTVIE POGRANICHNOGO SLOYA C GIPER-ZVUKOVYM POTOKOM V KONICHESKOM SOPLE] Surveys of Foreign Scientific and Technical Literature

V. P. Agafonov 16 May 1966 14 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Mekh. (Moscow), no. 5, 1965 p 154–157

(ATD-66-54)

In his introduction the author discusses calculation of gas-dynamic parameters of the flow, nozzle calculations, and calculation of the flow in a nozzle of given shape. He then points out that it is shown in this work that by using an integral continuity equation it is possible to close a system of equations and to solve the problem of supersonic flow in a conical nozzle with allowance for the interaction with the boundary layer. The results of the calculations indicate that, in general, the growth of the boundary layer during hypersonic gas flow in a conical nozzle can lead not only to a marked decrease in the size of the isentropic flow core, but also to the appearance of substantial irregularities in the distribution of all the gas-dynamic parameters in the transverse section of the nozzle. The original article included 3 references. Author

N66-32615*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

EFFECTS OF TWO VIBRATION-DISSOCIATION COUPLING MODELS ON NONEQUILIBRIUM HYPERSONIC FLOW OF NITROGEN OVER A WEDGE

Fred R. De Jarnette Washington, NASA, Aug. 1966 31 p refs

(NASA-TN-D-3521) CFSTI: HC $2.00/MF $0.50 CSCL 20D

The effects of the coupled vibration-dissociation (CVD) and coupled vibration-dissociation-vibration (CVDV) models on the inviscid, nonequilibrium flow over a wedge have been compared with the flow fields with no coupling (UVD model). The numerical method used for the flow-field computations makes use of Lax's finite-difference method but employs a modified-difference scheme on the wedge surface. Distributions of flow properties along and normal to the wedge surface are presented for the flow of nitrogen for free-stream Mach numbers of 15.25 and 23.76 past wedges with attached shock waves and wedge half-angles close to 43°. At the lower Mach number of 15.25 the CVD and CVDV models gave identical results. At the higher Mach number of 23.76, large differences were observed between all three coupling models. The CVD model was found to have a dissociation overshoot in addition to the vibrational overshoot, whereas the CVDV model eliminated both of these overshoots. It was further found that the thickness of the shock layer is largest for the CVDV model and smallest for the UVD model. As a result of the present investigation, it is concluded that the vibration-dissociation coupling does have a significant effect on the flow fields past finite bodies at the higher Mach numbers. Author

N66-32644*# General Applied Sciences Labs., Inc., Westbury, N. Y.

FINITE RATE EVAPORATION OF CRYOGENIC HYDROGEN IN TWO-PHASE AIR Technical Report No. 367

R. Edelman and H. Rosenbaum Sep. 1963 74 p refs
(Contract NAS8-2686)
(NASA-CR-76978) CFSTI: HC $2.50/MF $0.75 CSCL 20D

A theoretical study of two-phase continuum flow of hydrogen and air for a given range of initial conditions is presented. Of special interest is the method employed in calculating the two-phase boundary and subsequent condensation of the air during the hydrogen evaporation process. This involves assuming the presence of an arbitrarily small mass fraction of condensed air when the two-phase boundary for the air is crossed, and permits the calculation of the multiphase Gibbs potentials which are expressed in terms of mass fractions associated with each phase present. The ten parameters of the problem are in six mass fractions for the O_2, N_2, and H_2; the hydrogen particle temperature; the two-phase air and gas phase hydrogen temperature; the particle radius; and the overall degree of vaporization. The results indicate evaporation times on the order of 10^{-5} sec. for 1μ radius particles, for the range of conditions of interest here. Author

N66-32680*# Southwest Research Inst., San Antonio, Tex. Dept. of Mechanical Sciences.
MOMENT OF INERTIA AND DAMPING OF LIQUIDS IN BAFFLED CYLINDRICAL TANKS Technical Report No. 11
Franklin T. Dodge and Daniel D. Kana 4 Jun. 1965 33 p refs
(Contract NAS8-1555; SwRI Proj. 02-1072)
(NASA-CR-76915) CFSTI: HC $2.00/MF $0.50 CSCL 20D

The moment of inertia and the damping of a liquid in a completely filled, closed cylindrical tank is investigated experimentally for tanks with and without baffles. The results are compared with Bauer's mechanical model, and it is shown that a simpler model, which, however, is not conceptually correct for extremely large damping, is sufficient for cases where only small damping is expected. An approximate method of computing the liquid moment of inertia in a baffled tank is given. Author

13 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences.

N66-31443# Aeronautical Chart and Information Center, St. Louis, Mo. Linguistic Section.
EVALUATION ON THE EARTH'S MODEL OF THE PRECISION OF NUMEROV'S FORMULA FOR THE VERTICAL GRADIENT OF GRAVITY [OTSENKA TOCHNOSTI FORMULY NUMEROVA DLYA VERTIKAL'NOGO GRADIYENTA SILY TYAZHESTI NA MODELYAKH ZEMLI]
M. P. Ignatova May 1966 17 p refs Transl. into ENGLISH from Tr. Tsentral. Nauchn.-Issledovatel. Inst. Geodezii, Aeros'yemki i Kartografii (Moscow), issue 157, 1965 p 125–134
(TC-1027; AD-633405) CFSTI: HC $1.00/MF $0.50

Existing methods of computation of the vertical gradient making use of gravity anomalies, under assumption that these anomalies are being observed on a plane surface, are investigated. In reality, however, terrain is never perfectly flat. The influence of inclinations of the terrain was estimated with the help of the earth's models in the form of a truncated cone, a cone with a rounded-off apex, and a ravine of infinite extension. The case was also investigated when the anomalies created by a point mass are given on an inclined plane surface. Errors of the vertical gradient value reach several tenths of a percent. Author (TAB)

N66-31445# Aeronautical Chart and Information Center, St. Louis, Mo. Linguistic Section.
COMPUTATION OF THE FIRST AND SECOND VERTICAL DERIVATIVES OF GRAVITY FROM THE MAPS OF GRAVITY ANOMALIES [VYCHISLENIYE PERVOY I VTOROY VERTIKAL'NYKH PROIZVODNYKH SILY TYAZHESTI PO KARTAM YEYE ANOMALIY]
M. I. Yurkina May 1966 19 p refs Transl. into ENGLISH from Tr. Tsentral. Nauchn.-Issledovatel. Inst. Geodezii, Aeros'yemki i Kartografii (Moscow), issue 157, 1965 p 116–124
(TC-1026; AD-633404) CFSTI: HC $1.00/MF $0.50

On the basis of the solution proposed by Molodenskiy for his integral equation of density of a single layer on the physical surface of the earth (the said layer being substituted for the attraction of all the anomalous masses in the interior of the earth), expressions for determining the second vertical derivatives of the disturbing potential were obtained. Author (TAB)

N66-31542# Pennsylvania State Univ., University Park. Ionosphere Research Lab.
EFFECT OF TEMPERATURE CHANGES ON THE ELECTRON DENSITY DISTRIBUTION IN THE F_2-REGION OF THE IONOSPHERE II Interim Report
Y. V. Somayajulu 20 Apr. 1966 24 p refs *Its* Sci. Rept.-270
(Contract AF 19(628)-4014; Grant NSF GP-5611)
(AFCRL-66-313; AD-633302) CFSTI: HC $1.00/MF $0.50

In this report the problem of changes in the F_2-region electron density distribution caused by changes in the neutral gas temperature is investigated using an analytical representation of the equilibrium quiet-day electron density distribution under the influence of production, loss and diffusion. Using the currently accepted temperature dependences of these quantities it is concluded that the change caused in N_mF_2 is small and that under certain conditions N_mF_2 may increase or decrease. The main effect of temperature, under these conditions, is to increase the thickness of the F_2-region, in agreement with observation. It is also shown that to explain the large reduction in N_mF_2 in mid-latitudes during storms, the loss rate has to be quite sensitive to temperature. Author (TAB)

N66-31709# Atomic Energy Commission Research Establishment, Lucas Heights (Australia).
THE ESTIMATION OF EFFLUENT CONCENTRATIONS FROM AN ELEVATED CONTINUOUS SOURCE
E. Charash Dec. 1965 26 p refs
(AAEC-TM-307)

From fundamental theory and empirical knowledge of the structure of atmospheric turbulence spectra, diffusion equations were developed with parameters that are adjustable so as to reflect the influence of varying surface roughness as well as a wide range of stability conditions. Instructions are given for practical applications of the diffusion equations which should be valid for travel distances of about a mile at heights greater than fifty feet above ground. Author (NSA)

N66-31735# Institute for Petroleum Research and Geophysics, Azor (Israel).
GENERAL ASPECTS AND INITIAL RESULTS OF TELLUROMETRIC EXPERIMENTS IN ISRAEL

Tsvi Meidav and Alexander Klang Aug. 1965 53 p refs
(TM/390/65) CFSTI: HC $2.50/MF $0.50

Natural earth currents have taken increasingly greater role in geophysical exploration of large sedimentary basins. The method is based on the principle that the natural current sheets tend to concentrate in the sedimentary strata, and hence their relative density and potential drop over these strata reveal the changes in thickness of the sedimentary columns. Recent developments in theory and field technique elsewhere reveal that simultaneous recording of the magnetic field variations above the surface of the earth permit a quantitative determination of thickness of electrically different strata. The present series of experiments established the feasibility of the telluric technique in Israel, and resulted in mastery of appropriate field and analysis technique which permits the conversion of the tellurograms into geophysical cross sections. Specifications for suitable electrodes and recording equipment are enumerated, and recommendations for the further development of the technique are listed. Author

N66-31766*# Wisconsin Univ., Madison.
THE RADIATION BALANCE OF THE EARTH FROM A SATELLITE
Frederick Bishop House (Ph.D. Thesis) 1965 90 p refs
(Contract NASw-65)
(NASA-CR-76422) CFSTI: HC $2.50/MF $0.75 CSCL 08N

The measurement of albedo and long-wave radiation by the black omni-directional sensor on TIROS IV satellite is used to study the radiation balance of the earth. The method used to obtain these results using only a single sensor system is developed. Author

N66-31771# Hermanus Magnetic Observatory (South Africa).
RESULTS OF MAGNETIC OBSERVATIONS MADE AT SANAE STATION, 1963
A. du Plessis and A. M. van Wijk Nov. 1965 91 p *Its* Geophys. Ser. I
(B.5) CFSTI: HC $2.50/MF $0.75

Magnetic observations made at the South African Antarctic Base, (70 18'S, 02 22' W) are presented in graphs and tables, including hourly values of declination, and horizontal and vertical intensities, and mean dirunal variations. The program consisted of absolute observations of horizontal intensity and vertical intensity at a network of points. The variometer hut is described, and the mean monthly temperatures inside are listed. The magnetic recorder used was a La Cour normal-run storm magnetograph. Formulas for the declination, and horizontal and vertical intensity were adopted for the reduction of the magnetometer readings obtained. L.E.W.

N66-31803# California Univ., Livermore. Lawrence Radiation Lab.
LOW-ENERGY ATMOSPHERIC GAMMA-RAY SPECTRA AT HIGH ALTITUDES
K. A. Anderson, J. H. Primbach, G. Chodil, R. C. Jopson, Hans Mark et al 9 Dec. 1964 22 p refs
(Contract W-7405-ENG-48)
(UCRL-12210) CFSTI: HC $1.00/MF $0.50

The atmosphere contains large fluxes of cosmic ray photons in equilibrium with primary particles. These photons probably originate as a by-product of high-energy showers. Previous measurements at 40 kev and above indicate that the photon flux decreases rapidly as the quantum energy increases. The present measurements cover the energy region from 5 to 45 kev. A turnover in the spectrum should occur roughly at 40 kev due to strong photoelectric absorption in the air. Scintillation counters, flown on balloons at several locations, were employed to detect the gamma rays. The altitudes attained ranged from 33,500 to 36,600 meters. It was found that the spectrum has a maximum between 30 to 40 kev, and that the observed photon flux decreases below that quantum energy. At maximum altitude and at the maximum of the spectrum, the observed flux is approximately 2×10^{-2} photons sec^{-1} kev^{-1} cm^{-2} $ster^{-1}$. Measurements were made with gamma-ray counters pointing both up and down. It was found that the flux observed in both directions is approximately the same. Author (NSA)

N66-31887*# Geophysics Corp. of America, Bedford, Mass. GCA Technology Div.
MEASUREMENT OF UPPER ATMOSPHERIC IONIZATION AND WINDS WITH A COMBINED PAYLOAD Interim Report
L. G. Smith, J. F. Bedinger, and G. T. Best Jun. 1966 104 p refs
(Contract NASw-1083)
(NASA-CR-76482; GCA-TR-66-11-N) CFSTI: HC $3.00/MF $0.75 CSCL 04A

The relation between the structure of the electron density profile and wind in the E region is being studied using sounding rockets to obtain the electron density profile and to lay down the vapor trail used in obtaining wind data. A payload was developed which combines the canister of the vapor trail technique with Langmuir probe instrumentation for electron density observations. Several combined probe and vapor train payloads were constructed, including both TMA (trimethyl aluminum) and alkali vapor canister sections, and launched at Wallops Island and Fort Churchill. Details of the launches are discussed. The results of electron density and wind observations are also given. Spectral observations of sunlit trails were obtained with a spectrophotometer. This investigation and the temperature obtained are discussed. A similar instrument was used to observe the Comet Ikeya-Seki near Hawaii from an aircraft. These results are also presented. Some conclusions concerning the experimental methods and data as well as recommendations for future work are presented. R.N.A.

N66-31924# Defence Research Telecommunications Establishment, Ottawa (Ontario).
ALOUETTE I IONOSPHERIC DATA ALOSYN, 1-15 NOVEMBER 1963
1 Mar. 1966 188 p
CFSTI: HC $3.25/MF $1.25

Alosyn is Alouette topside sounder synoptic data. It consists of selected ionospheric parameters obtained from Alouette I ionograms. Tables of the parameters for all sounder data recorded during November, 1963 at several telemetry stations in Canada, Alaska, U.K., and the U.S.A. are given. The parameters are listed in the order in which the ionograms were recorded, one tabulation row for each ionogram. The Alouette I satellite is in an almost circular orbit with an inclination of 80.5°. The orbital period is 105.4 minutes. The topside sounder radio frequency changes continously from 0.5 to 11.5 Mc/s. The complete sweep takes about 11 seconds. The parameters tabulated are marked out on two ionograms which are depicted. The orbital position, local mean time, χ, gyrofrequency, and magnetic dip angle were calculated from computer programs. L.S.

N66-31931*# Geophysics Corp. of America, Bedford, Mass. Technolgoy Div.
SODIUM VAPOR EXPERIMENT Quarterly Progress Report No. 4, 1 Apr.-30 Jun. 1966
Jul. 1966 21 p refs
(Contract NAS5-3970)
(NASA-CR-76500) CFSTI: HC $1.00/MF $0.50 CSCL 04A

Further observations are given on the dynamics of the upper atmosphere made by analysis of the motion of sodium vapor trails ejected from sounding rockets. Variations in the large scale wind pattern are discussed, and figures illustrate the apparent downward motion of the pattern. Observations and conclusions concerning the existence of turbulence in the atmosphere, based on the visual appearance of vapor trails in the region around 100 km, are briefly reviewed, and photographs illustrate growth of the trail. L.E.W.

N66-31959# Weapons Research Establishment, Salisbury (Australia).
Feb. 1966 34 p
(WRE-CPD-1965/2(S)) CFSTI: HC $2.00/MF $0.50

Tabulations of the hourly ionospheric data obtained at Salisbury, South Australia for the month of February 1965 are presented. A brief description of the ionosonde from which the data were obtained is also included. H.S.W.

N66-31960# Technisch Documentatie en Informatie Centrum voor de Krijgsmacht, The Hague (Netherlands). Advies Bureau der Genie.
THE STRENGTH OF DIKES UNDER THE PRESSURE OF RAYLEIGH WAVES INITIATED BY NUCLEAR EXPLOSIONS [DE STANDZEKERHEID VAN DIJKEN ONDER INVLOED VAN RAYLEIGH-GOLVEN OPGEWEKT DOOR NUCLEARE EXPLOSIES]
R. W. Trense Feb. 1966 38 p refs In DUTCH *Its* Rept.-132 (TDCK-45622)

The connection between an earthquake and the size of a bomb is considered, along with the effects that an earthquake would have on a dike. Through mathematical analysis, it was determined that the outer layers of the dike are of great importance as protection against vibrations. In general, it was found that the resistance of dikes against the influence of Rayleigh waves is larger than the resistance against the movements of the base of the dike. The importance of knowing to what extent the roots of grasses dig into the dike is pointed out, and research is recommended to study the connection between the dynamic ground properties and the base values of the dikes. Transl. by J.O.

N66-31970# Joint Publications Research Service, Washington, D. C.
STUDY OF MULTIPLY REFLECTED WAVES DURING VERTICAL SEISMIC PROFILING
Ye. I. Gal'perin 11 Jul. 1966 27 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Fiz. Zemli (Moscow), no. 12, 1965 p 1-20
(JPRS-36413; TT-66-32845) CFSTI: $1.00

Review of the principal directions in the study of longitudinal multiply reflected waves is given. For the simplest case of structure of the medium the kinematic characteristics of multiple waves on a vertical profile is discussed. Analysis of experimental data shows that there are some new possibilities of study of multiple waves by the vertical seismic profiling method. Multiply reflected waves are one of the principal factors reducing the effectiveness of seismic investigations and their possibilities for exploration work. The presence of multiple waves on records can lead to an erroneous interpretation of seismic data, and as a result, can cause unnecessary drilling. During the last 20 years an enormous amount of experimental work has been done on multiple waves. The list of studies consists of more than 100 titles. Multiply reflected waves have been studied in three principal aspects: (1) detection of multiple waves on seismograms, (2) study of multiple waves, their kinematic and dynamic characteristics, (3) suppression of multiple waves. Author

N66-31993# Institut Franco-Allemand de Recherches, St. Louis (France).
PRELIMINARIES TO THE EXPERIMENTAL STUDY OF SEISMIC SHOCKS [PRELIMINAIRES A L'ETUDE EXPERIMENTALE D'EBRANLEMENTS SISMIQUES]
F. Hagry 30 Dec. 1965 44 p refs In FRENCH; GERMAN summary
(ISL-T-48/65) CFSTI: HC $2.00/MF $0.50

The effect of air shock induced earth tremors on the mechanical behavior of subterranean structures is examined. Possibilities for experimental analysis by means of the photoelastic method are pointed out. An explanation of the difficulties encountered by using the photoelastic method in the observation of dynamic processes is given, and results obtained during observations are presented. Transl. by K.W.

N66-31997# India. Meteorological Dept., New Delhi.
MAGNETIC, METEOROLOGICAL AND ATMOSPHERIC ELECTRIC OBSERVATIONS MADE AT THE GOVERNMENT OBSERVATORIES BOMBAY AND ALIBAG IN THE YEAR 1953 (1874-1875 SAKA). PART I: MAGNETIC OBSERVATIONS MADE AT ALIBAG
1964 71 p
CFSTI: HC $2.50/MF $0.75

The results of the geomagnetic observations made at the magnetic observatory at Alibag, India during 1953 are tabulated. The details of magnetic disturbances recorded are included, and it is reported that there were 2 great, 18 moderate, and 225 smaller disturbances. A few magnetograms made on days when disturbances occurred are appended. H.S.W.

N66-31998# India. Meteorological Dept., New Delhi.
MAGNETIC, METEOROLOGICAL AND ATMOSPHERIC ELECTRIC OBSERVATIONS MADE AT THE GOVERNMENT OBSERVATORIES BOMBAY AND ALIBAG IN THE YEAR 1956 (1877-1878 SAKA). PART I: MAGNETIC OBSERVATIONS MADE AT ALIBAG
1965 72 p
CFSTI: HC $2.50/MF $0.75

Tabulations of the geomagnetic observations made at the Alibag observatory during 1956 are presented. During the year, one very great disturbance was reported, in addition to 6 great, 26 moderate and 204 days of smaller disturbances. Appended are samples of magnetograms that were recorded during the magnetic disturbances. H.S.W.

N66-32015*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A DEVELOPMENT OF THE EARTH'S GRAVITATIONAL POTENTIAL FROM THE SIXTH THROUGH THE TWELFTH ZONAL HARMONIC
Theodore L. Felsentreger *In its* Publ. of Goddard Space Flight Center, 1963, Vol. I, [1963] p 245-247 refs (See N66-32006 18-30) GPO: HC $9.75; CFSTI: MF $7.50

The purpose of this report is to express that part of the earth's gravitational potential from the sixth zonal harmonic through the twelfth, along with its partial derivatives with respect to an inertial geocentric coordinate system, in a form suitable for inclusion in the numerical integration of position partial derivatives for an earth satellite. Values for the harmonic coefficients are also given. Author

N66-32018*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
TESSERAL HARMONICS OF THE GRAVITATIONAL FIELD AND GEODETIC DATUM SHIFTS DERIVED FROM CAMERA OBSERVATIONS OF SATELLITES
William M. Kaula *In its* Publ. of Goddard Space Flight Center, 1963, Vol. I [1963] p 330–342 refs (See N66-32006 18-30) GPO: HC $9.75; CFSTI: MF $7.50

Baker–Nunn camera observations of satellites 1959 $\alpha 1$ over 315 days, 1959 η over 105 days, and 1960 $\iota 2$ over 294 days were analyzed for 35 spherical harmonic coefficients of the earth's gravitational field and for position shifts of six geodetic datums. Of the three satellites, only 1960 $\iota 2$ appeared to have a sufficiently good observation distribution and small enough drag effects to yield significant results. The datum shifts obtained have standard deviations averaging ±25 m in each coordinate. The gravitational harmonic coefficients obtained appear to be appreciably different from zero for indices (n,m) at (2,2), (3,1), (4,1) and (4,3). In particular, geophysically significant magnitudes were obtained for J_{22}: 2.51×10^{-6} and J_{31}: 1.79×10^{-6} (normalized). Author

N66-32022*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
STRESS DIFFERENCES AND THE REFERENCE ELLIPSOID
John A. O'Keefe and William M. Kaula *In its* Publ. of Goddard Space Flight Center, 1963, Vol. I [1963] p 462–463 refs (See N66-32006 18-30) GPO: HC $9.75; CFSTI: MF $7.50

A connection made by Hulley between gravity anomalies and other geophysical phenomena, including faults and the pole positions, is discussed. It is stated that this suggestion is not substantiated mathematically. An illustration of a plot of the values of the gravity anomalies referred to an ellipsoid with a flattening of 1/300 is shown, and when this is compared to Hulley's work, there is an indication that there may be a relation between the tectonic activity and gravity anomalies. H.S.W.

N66-32024*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
IONOSPHERE ELECTRON TEMPERATURE MEASUREMENTS AND THEIR IMPLICATIONS
H. L. Brace, N. W. Spencer, and G. R. Carignan (Michigan Univ.) *In its* Publ. of Goddard Space Flight Center, 1963, Vol. I [1963] p 666–676 refs (See N66-32006 18-30) GPO: HC $9.25; CFSTI: MF $7.50

Electron temperature and ion density data, reported earlier in preliminary form, are reviewed in terms of their consistency with recent theories regarding thermal equilibrium in the daytime ionosphere. On the basis of these daytime data and the ionosphere theory, we conclude that solar extreme ultraviolet radiation (EUV) is the dominant heat source in the quiet midlatitude ionosphere. This conclusion is suggested by the agreement between the electron temperature profiles measured under these conditions and theoretically predicted profiles based on EUV radiation as the only heat source. Measurements in the disturbed midlatitude and auroral zone ionospheres suggest that, although EUV remains the dominant heat source for electrons in the F_1 region, an additional heat source is effective in the E and F_2 regions. Its effect is to extend the region of thermal nonequilibrium both upward into the upper F region and downward into the E region. The results of a more recent flight in the nighttime ionosphere are presented and discussed. A horizontal gradient in electron temperature found in the nighttime ionosphere is believed too abrupt to permit a similar gradient in the gas temperature and thus indicates that small but variable degrees of thermal nonequilibrium can exist in the nighttime ionosphere. This is believed to be because of particle fluxes whose heating effects are enhanced by the low values of electron density existing in the nighttime F region. Author

N66-32025*# Alaska Univ., College. Geophysical Inst.
TWENTY-FOUR-HOUR OBSERVATIONS OF AURORA AT THE SOUTHERN AURORAL ZONE
T. N. Davis and R. N. De Witt *In* NASA. Goddard Space Flight Center Publ. of Goddard Space Flight Center, 1963, Vol. I [1963] p 850–853 refs (See N66-32006 18-30) GPO: HC $9.75; CFSTI: MF $7.50
(Grant NSF G-14782)

The west-to-east reversal in longitudinal auroral motions is observed at Byrd, Antarctica, as at other auroral zone stations. Because of the high geographic latitude of the station, it is possible to see the aurora throughout the day, and a second reversal in longitudinal motion is observed. This reversal, from eastward to westward motion, tends to occur approximately 10 hours later than the nighttime reversal. The morphology of the 'daytime' aurora is described here; it differs in several ways from that of the aurora commonly observed in the hours near local midnight at this and other auroral zone stations. Author

N66-32030*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
OSCILLATION OF THE GEOMAGNETIC FIELD LINE AND ASSOCIATED MAGNETIC PERTURBATIONS AT CONJUGATE POINTS
Masahisa Sugiura and Charles R. Wilson (Alaska Univ.) *In its* Publ. of Goddard Space Flight Center, 1963, Vol. I [1963] p 1160–1164 refs (See N66-32006 18-30) GPO: HC $9.75; CFSTI: MF $7.50
(Contract AF 19(604)-7988; Grant NSF G-14734)

By means of an idealized elastic string model, the symmetry relations in the magnetic perturbation at a pair of conjugate points due to oscillation of the lines of force of the geomagnetic field are studied. For oscillations of odd modes the change in H(ΔH) is parallel, and that in the east component (ΔD) is antiparallel at the conjugate points, whereas for oscillations of even modes ΔH is antiparallel and ΔD is parallel at the conjugate points. Hence in the former case the polarizations (as viewed downward) at the conjugate points are mirror images of each other with respect to the meridian plane, and in the latter case they are mirror images with respect to the equator. Several examples indicating these symmetry relations are presented. Author

N66-32035*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ACOUSTIC HEATING OF THE POLAR NIGHT MESOSPHERE

Kaichi Maeda *In its* Publ. of Goddard Space Flight Center, 1963. Vol. I [1963] p 1388–1401 refs (See N66-32006 18-30) GPO: HC $9.75; CFSTI: MF $7.50

As a part of the dynamical heating of the upper atmosphere, which has been emphasized by Hines, the acoustic heating of the upper air is reinvestigated, particularly the warming of the polar night mesosphere. It is shown that because of the relatively small transmissivity of the thermosphere for long period sound waves, most acoustic heating does not take place above the 200 km level, but rather below 100 km or around the mesopause, and that although the acoustic output power from the polar jet stream is more than 10^5 times larger in winter than in summer, acoustic heating is not sufficient to compensate for the cooling rate around the mesopause in winter, unless the wind velocity of the polar night jet stream continually exceeds 200 m/sec. Author

N66-32036*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.

AURORAL DISSOCIATION OF MOLECULAR OXYGEN IN THE POLAR MESOSPHERE

Kaichi Maeda *In its* Publ. of Goddard Space Flight Center, 1963. Vol. I [1963] p 1402–1414 refs (See N66-32006 18-30) GPO: HC $9.25; CFSTI: MF $7.50

As had been shown by Kellogg, one of the most effective mechanisms for heating of the polar mesosphere during polar night is the exothermic association of atomic oxygen intensified by the large-scale subsidence of the upper polar atmosphere in winter. Since photodissociation is no longer predominant in the polar regions in winter, the contribution of auroral particles to the dissociation of molecular oxygen is estimated, assuming the atmospheric composition given by Johnson. It is shown that the maximum rate coefficient is of the order of 10^{-8} $(cm^3\ sec)^{-1}$ for protons and electrons of energy spectrum $E^{-n}dE$, where $n \geq 3$, and that the height of maximum dissociation is around 90 km. Consequently, the rate of corpuscular dissociation of oxygen molecules in the upper mesosphere during strong auroral activities is comparable with that of photodissociations, which is mostly due to the Schumann–Runge continuum of solar ultraviolet radiations. Author

N66-32037*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.

MASS SPECTROMETRIC INVESTIGATIONS OF THE ATMOSPHERE BETWEEN 100 AND 227 KM ABOVE WALLOPS ISLAND, VIRGINIA

Edith Meadows-Reed and Charles R. Smith *In its* Publ. of Goddard Space Flight Center, 1963. Vol. I [1963] p 1415–1424 refs (See N66-32006 18-30) GPO: HC $9.75; CFSTI: MF $7.50

The diffusive separation of argon and nitrogen was measured by means of a Bennett radio frequency mass spectrometer carried on an Aerobee-150A rocket. The primary purpose of the spectrometer measurements was to obtain temperature latitude diffusive separation data to compare with those measurements obtained in the arctic (Fort Churchill, Canada) during the International Geophysical Year. The results indicated that diffusive separation occurred above about 111 km and that the altitude profile of the A/N_2 ratio is somewhat similar to that obtained during the two night flights in the arctic atmosphere. Author

N66-32038*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.

ROCKET MEASUREMENT OF THE STRUCTURE OF THE UPPER STRATOSPHERE AND MESOSPHERE

W. Nordberg and W. Smith *In its* Publ. of Goddard Space Flight Center, 1963. Vol. I [1963] p 1445–1454 refs (See N66-32006 18-30) GPO: HC $9.75; CFSTI: MF $7.50

A brief review of the results of rocket soundings of the upper stratosphere and mesosphere initiated during IGY, and a more detailed discussion of the soundings from Wallops Island are presented. The data obtained from the latter tests are compared to the data obtained at Fort Churchill, and the temperature differences recorded are pointed out. One fact which is noted is that there appears to be a layer between 60 and 65 km where the temperature at all points at all seasons remains constant. It is stated that simultaneous launchings at both locations should provide additional information on this matter. H.S.W.

N66-32086# Texas A&M Research Foundation, College Station.

NORTHEAST GULF OF MEXICO HYDROGRAPHIC SURVEY DATA COLLECTED IN 1965

R. D. Gaul, R. E. Boykin, and D. E. Letzring Apr. 1966 212 p refs

(Contract Nonr-2119(04))

(Rept.-66-8T; AD-633424) CFSTI: HC $6.00/MF $1.25

This report summarizes data collected during periodic hydrographic surveys made in 1965 over the continental shelf and slope of the northeast Gulf of Mexico. The survey region extends from the Mississippi Delta to Cape San Blas, Florida (about 300 nautical miles) and offshore to about the 1,000 fathom depth contour (100 to 110 nautical miles). Hydrographic observations consisted mainly of vertical profiles of temperature and salinity obtained by means of bathythermographs and salinity determinations of water samples taken at selected depths or by a salinity/temperature/depth (STD) instrument. In addition, several thousand drift bottles were released at selected locations in the survey area. Author (TAB)

N66-32098# American Committee for the Weizmann Inst. of Science, Inc., New York.

FREE OSCILLATIONS OF THE EARTH AND TIDES IN THE OCEAN Final Report, Oct. 1, 1955–Sep. 30, 1965

C. L. Pekeris 10 Apr. 1966 16 p refs

(Contract Nonr-1823(00))

(AD-633097) CFSTI: HC $1.00/MF $0.50

Contents: The free oscillations of the earth; the inverse probelm; solution of Laplace's tidal equations for the real world oceans; determination of the average depth in the real world oceans in a 1° mesh; methods of evaluating integrals of oscillatory functions. TAB

N66-32100# Office of Naval Intelligence, Washington, D. C. Translations Section.

CERTAIN RESULTS OF AEROELECTROPROSPECTING BY THE METHOD OF A ROTATING MAGNETIC FIELD [NEKOTORYE PEZUL'TATY AEROELEKTRORAZVEDOCHNYKH RABOT METODOM VRASHCHAYUSHCHEGOSVA MAGNITNOGO POLYA]

Yu. B. Shaub [1966] 9 p Transl. into ENGLISH from the publ. "Electromagnetic Probing and Mangetotelluric Methods of Prospecting" Leningrad Univ. Publishing House, 1963 p 178–185 Presented at the All-Union Conf., 1963

(ONI-TRANS-1000-C, TT-66-61321; AD-633321) CFSTI: HC $1.00/MF $0.50

Rotating the magnetic field is found to be an efficient method of aeroelectroprospecting that can be accomplished during daylight hours under practically any weather conditions

that permit flying. Sensitivity is found to be significantly higher than in the single airplane induction method. Two-type LI-2 airplanes, which could carry a comparatively large trailing gondola and permit the realization of generating loops with a large magnetic moment, were used in the initial experiments. In one airplane was a rack with a block of measuring apparatus, automatic recorders, and a power supply block; as well as a winch with a cable, and the trailing apparatus with an emergency cut-off cable. The second airplane contained the quartz master oscillator and two amplifiers with output power of 50 watts each. Measurement of electromagnetic and vibration noise levels was made by the first airplane at 900 meters; and the measurement of noise determined by departure of the magnetic measuring set-up from the assigned geometry was carried out at the same altitude, but with a cooperative flight of the two airplanes and with normal excitation of the generating loops. M.W.R.

N66-32101# California Univ., Berkeley. Dept. of Civil Engineering.

BEHAVIOR OF STABILIZED SOILS UNDER REPEATED LOADING. REPORT I: BACKGROUND, EQUIPMENT, PRELIMINARY INVESTIGATIONS, REPEATED COMPRESSION AND FLEXURE TESTS ON CEMENT-TREATED SILTY CLAY

James K. Mitchell, Chih-kang Shen, and Carl L. Monismith Dec. 1965 136 p refs

(Contract DA-22-079-ENG-414)

(Rept.-3-145; AD-632802) Available from Army Engr. Waterways Expt. Sta., Vicksburg, Miss.: $1.00

Current methods of pavement design using stabilized soils as components of the pavement structure generally base selection of both quality and thickness of those materials on static tests such as the California Bearing Ratio procedure. To validate such procedures, the objectives of these studies are to evaluate the behavior of stabilized soils under dynamic loading conditions and develop improved criteria for quality design and thickness selection within a more rational framework. More specifically the study is concerned with examination of soil stabilization requirements established by the Corps of Engineers for military roads and airfields in the theater of operations within this framework. Two soils, Vicksburg Silty Clay and Vicksburg Buckshot Clay, were selected for study because of the considerable performance data on these soils and because, through suitable treatment, they fall within the range of stabilization requirements of the Corps. To date, most of the dynamic testing has been performed on the treated silty clay. In general the results obtained to meet Corps' criteria for CBR and compressive strength can withstand repeated compressive and flexural stresses of the magnitude and number prescribed for different classes of military operations. However, more detailed investigation of the influence of water content, mixing procedures, and method of compaction are required since the data obtained show that these variables significantly affect the strength and resilience characteristics of the cement-treated silty clay. Author (TAB)

N66-32106*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

ON THE PROBABLE INFLUENCE OF HIGHER ORDER EARTH GRAVITY IN THE DETERMINATION OF THE EQUATORIAL ELLIPTICITY OF THE EARTH FROM THE DRIFT OF SYNCOM II OVER BRAZIL

C. A. Wagner Washington, NASA, Aug. 1966 25 p refs (NASA-TN-D-3314) CFSTI: HC $1.00/MF $0.50 CSCL 08N

This document gives calculations from the best available geodetic sources showing that the Syncom II–Brazil second-order earth gravity experiment reported earlier by this author probably contained a small but significant bias due to higher order earth gravity. This bias is estimated by "extrapolation" from these sources. Bounds on the true ellipticity of the earth's equator are derived by combining the best estimate of this bias with the actual Syncom II drift measurements. These bounds, though somewhat wider than measured by Syncom II (over Brazil) alone, should be absolute and the target for all future investigations into longitude-dependent earth gravity. Author

N66-32110*# Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.

EXPERIMENTAL INVESTIGATION OF ULTRA-HIGH VACUUM ADHESION AS RELATED TO THE LUNAR SURFACE Eighth Quarterly Progress Report and Second Year Summary, 1 Apr.–30 Jun. 1966

J. A. Ryan 26 Jun. 1964 48 p refs

(Contract NAS7-307)

(NASA-CR-76430; DAC-59288) CFSTI: HC $2.00/MF $0.50 CSCL 08G

The ultra-high vacuum adhesion of silicates as related to the lunar surface was studied. Silicates, such as may exist at the lunar surface, were contacted with silicates and engineering materials which may be used at the lunar surface. Adhesion force was measured as a function of load force, crystalline orientation, surface roughness, and type of forepump used. Two types of adhesional behavior were found for the air-formed surfaces. The first appeared only under load, increasing rapidly with increasing load; was of relatively large magnitude; and was present only at ultra-high vacuum. Extensive surface damage and material transfer also were noted. This behavior is caused by the action of the normal silicate atomic bonding forces. The second type was present at zero load, showed little load dependence, was of relatively low magnitude, persisted in dry nitrogen, and did not produce surface damage or material transfer. This behavior is most probably caused by the action of the dispersion forces. For the vacuum-cleaved samples, the adhesion was much larger than that observed for the air-formed samples. A strong long-range attractive force, indicative of considerable surface charging, was noted. The results indicate that the primary contributor to the observed adhesion is the normal silicate bonding forces, and also that the long range force is caused by a statistical charge separation produced during cleavage. Results indicate that silicate adhesion can be the major factor in determining the behavior of lunar materials and that its precise role is critically dependent upon the nature of the contacting surfaces. Author

N66-32134*# Washington Univ., Seattle. Dept. of Atmospheric Sciences.

ON THE USES OF INTERMEDIATE INFRARED AND MICROWAVE INFRARED IN METEOROLOGICAL SATELLITES Third Semiannual Report

Konrad J. K. Buettner, Robert W. Dana, Kristine Katsaros, William T. Kreiss and Irmgard Stuetzer Mar. 1966 32 p refs

(Grant NsG-632)

(NASA-CR-76620) CFSTI: HC $2.00/MF $0.50 CSCL 08E

During this period work progressed on the analysis of the Nimbus HRIR grid point data, theoretical studies of surface emissivity in the intermediate infrared region, and meteorological modeling for the microwave study. Modifications and calibrations of the microwave radiometer are nearly

completed. Plans for further experimental emissivity measurements in the intermediate infrared region are outlined. Author

N66-32161# Massachusetts Inst. of Tech., Cambridge.
OCEANOGRAPHIC RESEARCH AT M.I.T. IN THE DEPARTMENT OF GEOLOGY AND GEOPHYSICS AND THE DEPARTMENT OF METEOROLOGY Progress Report, 1 Jan.–31 Dec. 1965
Feb. 1966 22 p refs
(Contract Nonr-1841(74))
(PR-4; AD-632018) CFSTI: HC $1.00/MF $0.50

Summaries are presented of researches relating to oceanography completed by the department of geology and geophysics and the department of meteorology; and the program for the fourth annual oceanographic research conference is reviewed. M.W.R.

N66-32210# Joint Publications Research Service, Washington, D. C.
SOVIET-BLOC RESEARCH IN GEOPHYSICS, ASTRONOMY, AND SPACE, NO. 136
18 Jul. 1966 78 p refs
(JPRS-36553; TT-61-11147-136)

News releases and abstracts of scientific and technical articles gathered from publications of the Sino-Soviet Bloc countries are presented. Subject matter covered includes astronomy, meteorology, oceanography, terrestrial geophysics, and upper atmosphere and space research. H.S.W.

N66-32222# Teledyne, Inc., Alexandria, Va. Earth Sciences Div.
THE PARTIAL COHERENCY STUDY. PART ONE: COHERENCE TESTS ON SEISMIC NOISE MODELS. PART TWO: A PRELIMINARY ANALYSIS WITH SEISMIC NOISE RECORDED IN AN ARRAY FROM THE CUMBERLAND PLATEAU SEISMOLOGICAL OBSERVATORY Progress Report
Loren D. Enochson (Meas. Analysis Corp.) and Robert H. Shumway (Westat Res., Inc.) 11 May 1966 50 p ref Prepared jointly with Meas. Analysis Corp. and Westat Res., Inc.
(Contract AF 33(657)-15919; ARPA Order 624; Proj. Vela Uniform)
(Rept.-146; AD-632959) CFSTI: HC $2.00/MF $0.50

This report, divided into two parts, discusses the partial coherence function as a quantitative measure of linear relationship between two variables. Under appropriate conditions, the partial coherance between two variables will provide a more pertinent measure of their relationship than will ordinary coherence functions. Part one is concerned with the theoretical problem of determining the structure of seismic noise in an array of seismometers. Part two is concerned with applying the theory to an actual array of seismometers, located at the Cumberland Plateau Seismological Observatory. Author (TAB)

N66-32223# Massachusetts Inst. of Tech., Cambridge. Soil Mechanics Div.
QUANTITATIVE FABRIC OF CONSOLIDATED KAOLINITE Phase Report No. 4
R. Torrence Martin Sep. 1965 82 p refs *Its* Contract Rept.-3-101
(Contract DA-22-079-ENG-330)
(R65-47; AD-632061) CFSTI: HC $3.00/MF $0.75

Structure is the combination of the geometrical arrangement of particles and the forces operating between them. The geometrical arrangement of particles and associated voids is called fabric and is the component of structure that is most amenable to measurement. Since the structure concept has been invoked to explain so many features of clay behavior, a reliable quantitative method for determining the fabric of a moist clay is extremely important. A method is described for quantitatively expressing orientation of kaolinite particles in a wet clay mass. Wet clay is impregnated with a polyacohol which permits grinding of a very flat surface (without disrupting the original fabric) for quantitative X-ray measurement. In the specific procedure discussed, a Norelco diffractometer equipped with a pole figure device and a Gieger detector was employed to measure by reflection the diffracted intensity of the 002 and 020 kaolinite reflections. The amplitude of the 002 peak to the amplitude of the 020 peak is called the peak ratio, PR, which quantitatively expresses particle orientation at any chosen angle to the specimen surface. For the kaolinite investigated, fabric varied from random to maximum orientation. Author (TAB)

N66-32251*# State Univ. of Iowa, Iowa City. Dept. of Physics and Astronomy.
ELECTRODYNAMICS OF THE MAGNETOSPHERE: GEOMAGNETIC STORMS
Syun-Ichi Akasofu May 1966 331 p refs *Its* Rept.-66-19
(Grants NsG 233-62; NsG-201-62; NSF GP-2721)
(NASA-CR-76676) CFSTI: HC $4.25/MF $1.75 CSCL 08N

Geomagnetic and auroral storms provide a great deal of detailed information on the interaction between the solar plasma flows and the magnetosphere. Vast numbers of observations have been accumulated, and many theories have been developed to explain them. However, many of the most vital features of the interaction remain unsolved. The purpose of this paper is to provide the background for future work by summarizing fundamental morphological data and by reviewing critically the proposed theories. The paper consists of four sections. In the first section, the structure of the solar plasma flows and the magnetosphere are briefly discussed. Effects of the direct impact of the plasma flows on the magnetosphere are described in section 2. Both sections 3 and 4 are devoted to the discussion of the major phase of geomagnetic storms, namely the formation of the asymmetric ring current belt and the development of the auroral and polar magnetic substorms, respectively. Author

N66-32269*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
CONJUGATE INTERSECTS TO SELECTED GEOPHYSICAL STATIONS
J. G. Roederer (NAS-NRC), W. N. Hess, and E. G. Stassinopoulos *In its* Goddard Space Flight Center Contrib. to the COSPAR Meeting, May 1965 Jul. 1966 p 35–131 refs (See N66-32266 18-30) CFSTI: HC $7.00/MF $1.50

Geomagnetic field lines are traced into space for more than 500 geophysical stations, using the 48-term Jensen and Cain field expansion for 1960. Total field intensity, magnetic dip, declination, and L-values are computed at each station, and at points 300 and 400 km vertically above the station. Coordinates and B values of the conjugate intersects and of the equatorial (minimum B) points are determined for each field line, as well as the total arc length of the line between origin and conjugate intersect. A general discussion of the resulting tables is given. Finally, a series of maps showing constant B and L contours at various levels between surface and 3,000 km are reproduced. Author

N66-32271*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SOUTHERN HEMISPHERE ANOMALIES
J. G. Roederer (NAS-NRC) *In its* Goddard Space Flight Center Contrib. to the COSPAR Meeting, May 1965 Jul. 1966 p 171–182 refs (See N66-32266 18-30) CFSTI: HC $7.00/MF $1.50

The eccentricity of the geomagnetic dipole and the presence of multipole perturbations give rise to a series of phenomena observable in the southern hemisphere which are important to the physics of the magnetosphere and ionosphere, and to the study of cosmic rays. In the first part of this review, the morphology of the geomagnetic field peculiarities in the southern hemisphere will be analyzed. In the second part, some of the efforts on cosmic rays, geomagnetically trapped radiation and the ionosphere will be discussed. Author

N66-32274*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
HEAT BUDGET OF THE SOUTHERN HEMISPHERE
S. I. Rasool and C. Prabhakara *In its* Goddard Space Flight Center Contrib. to the COSPAR Meeting, May 1965 Jul. 1966 p 221–232 refs (See N66-32266 18-30) CFSTI: HC $7.00/MF $1.50

Analysis has been carried out of radiation measurements made by the Tiros VII satellite covering a period of one full year. The annual heat budget has been computed separately for the northern and southern hemispheres. It is found that there is a northward flux of heat across the equator of $\approx 40\times10^{18}$ calories/day by transport of water vapor. As the two hemispheres are individually in radiative balance with space, this northward flux of heat must therefore be compensated by southward transport of heat by ocean currents and the atmosphere. Seasonal variations in the intensity of meridional transport of heat in the southern and northern hemispheres have also been examined. It is found that in the months of December, January and February there is a large northward flux of heat at all latitudes between 20 degrees S and 90 degrees N. During the other three seasons the flux is moderate and is predominantly southward at all latitudes between 15 degrees N and 90 degrees S. Author

N66-32275*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SOME ENERGY IMPLICATIONS OF DIRECT MEASUREMENTS OF THERMOSPHERE STRUCTURE
N. W. Spencer, L. H. Brace, G. R. Carignan, D. R. Taeusch, and H. Niemann (Michigan Univ.) *In its* Goddard Space Flight Center Contrib. to the COSPAR Meeting, May 1965 Jul. 1966 p 233–240 refs (See N66-32266 18-30) CFSTI: HC $7.00/MF $1.50

Four rocket-borne ejectable instruments (called thermosphere probes), launched into the thermosphere above Wallops Island, have measured the concentration and temperature of molecular nitrogen and electrons under various atmospheric conditions during the period approaching solar minimum. A fixed-tuned omegatron mass spectrometer mounted within an orificed chamber was employed for the N_2 concentration measurements. The gas temperature was derived from the N_2 scale height, and in some cases measured directly by a velocity scan technique. Cylindrical and hemispherical Langmuir probes were employed for the electron temperature and density measurements. Author

N66-32276*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
LATITUDINAL VARIATIONS OF ELECTRON TEMPERATURE AND CONCENTRATION FROM SATELLITE PROBES
L. H. Brace and B. M. Reddy *In its* Goddard Space Flight Center Contrib. to the COSPAR Meeting, May 1965 Jul. 1966 p 241–255 refs (See N66-32266 18-30) CFSTI: HC $7.00/MF $1.50

Measurements of electron temperature (T_e) and concentration (N_e) have been made by the use of cylindrical electrostatic probes on the Explorer XXII (1964 64A) satellite, which was launched in October 1964. Since the satellite is in an 80 degree inclination, nearly circular orbit at 1000 kilometers altitude, the latitudinal structure of the ionosphere is most easily determined. The measurements reveal a remarkable symmetry about the magnetic equator which suggests a strong degree of geomagnetic control. In the daytime a maximum of N_e occurs at the equator ($\approx 3\text{–}4\times10^4$/cc), and N_e decreases to a minimum at 50–60 degrees N and S magnetic latitude ($\approx 1\times10^4$/cc). In the daytime, T_e varies somewhat inversely with N_e, reaching a maximum at 50–60 degrees ($\approx$3000°K), a maximum at the equator ($\approx$2400°K), and decreasing in the polar regions. At night, the equatorial maximum disappears and pronounced maxima develop at about 35–40 degrees latitude ($\approx 3\times10^4$/cc). A steep gradient at higher latitudes ends in a deep trough in the auroral zone ($\approx 10^3$/cc). The nighttime T_e remains very low ($\approx$800°K) at low and middle latitudes but rises steeply near the auroral trough ($\approx$2500°K) and decreases at higher latitudes. Author

N66-32277*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ROCKET OBSERVATIONS OF THE STRUCTURE OF THE MESOSPHERE
W. Nordberg, L. Katchen, J. Theon, and W. S. Smith *In its* Goddard Space Flight Center Contrib. to the COSPAR Meeting, May 1965 Jul. 1966 p 257–274 refs (See N66-32266 18-30) CFSTI: HC $7.00/MF $1.50

Pressure, density, temperature and wind measurements in the upper stratosphere and in the mesosphere resulted from a total of 53 rocket-grenade soundings conducted during the period 1960–1965. Most of the soundings were performed over North America (Wallops Island, 38N and Churchill, 59N) but some results were also obtained over the tropical Atlantic (Ascension Island, 8S) and over Northern Europe (Kronogard, 66N). Soundings were carried out simultaneously at these sites and were coordinated with soundings measuring similar parameters over other areas of the globe. Seasonal and latitudinal variations in the structure and circulation of this region of the atmosphere were derived from the results. Author

N66-32278*# Imperial Coll. of Science and Technology, London, (England). Dept. of Geophysics.
THE IN-SITU DETECTION OF THE MID-LATITUDE S_q CURRENT SYSTEM
K. Burrows and S. H. Hall *In* NASA. Goddard Space Flight Center Goddard Space Flight Center Contrib. to the COSPAR Meeting, May 1965 Jul. 1966 p 275–288 refs (See N66-32266 18-30) CFSTI: HC $7.00/MF $1.50

Two British Skylark research rockets, each carrying a proton magnetometer, were flown from the Woomera Rocket Range, South Australia, in March 1964. The first flight merely recorded an approximately inverse cube law variation of magnetic field with height, but on the second flight a magnetic discontinuity of approximately 24γ amplitude was recorded. These results are consistent with ground observations at the times of the two flights and they establish experimentally the existence of an electric current system in the E region of the ionosphere over South Australia. The height and vertical thickness of the current are, however, not in close agreement with theoretical predictions. Author

N66-32279*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

ROCKET MEASUREMENTS OF MIDLATITUDE S_q CURRENTS

T. N. Davis, J. D. Stolarik, and J. P. Heppner *In its* Goddard Space Flight Center Contrib. to the COSPAR Meeting, May 1965 Jul. 1966 p 289-299 refs (See N66-32266 18-30) CFSTI: HC $7.00/MF $1.50

Rubidium-vapor magnetometers were flown to altitudes near 150 kilometers over Wallops Island, Virginia in four Nike-Apache rockets. Two flights were made at times when no ionospheric current was expected and none was encountered. The other two flights measured a current sheet with lower edge at 105 kilometers and upper edge at 123 kilometers, with the total current being in agreement with that expected from the ground observations. Author

N66-32285*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

TEMPERATURE, PRESSURE, DENSITY, AND WIND MEASUREMENTS IN THE UPPER STRATOSPHERE AND MESOSPHERE, 1964

W. Smith, J. Theon, L. Katchen, and P. Swartz Washington, NASA, Aug. 1966 85 p refs

(NASA-TR-R-245) CFSTI: HC $3.00/MF $0.75 CSCL 04A

Complete data from 30 rocket-borne experiments at Wallops Island, Virginia, Churchill, Manitoba, Canada, and Ascension Island in the South Atlantic Ocean are presented. Temperatures, pressures, densities, and wind velocities have been derived from recorded times of explosions and sound arrivals in the grenade experiment and from impact and static pressure measurements in the pitot-static tube experiment, but no attempt has been made to analyze the meteorological significance of these measurements. Error analyses are included for the results of each of the 27 grenade experiments. Tabulated grenade experiment results from Churchill in 1956 to 1958 and Guam in 1958 are presented as an appendix. Author

N66-32307# Newcastle Univ. (Australia).

CONTRIBUTIONS FROM THE UNIVERSITY OF NEWCASTLE TO THE SYMPOSIUM ON GEOMAGNETIC MICROPULSATIONS

F. T. Bagnall et al [1965] 37 p refs Symp. held at Tasmania Univ., Hobart, Australia, 23-24 Aug. 1965

(Grant Nonr(G)-00027-65)

(AD-632875) CFSTI: HC $2.00/MF $0.50

Micropulsation detection equipment and parameters are discussed. A brief summary, containing references to the findings of other investigators, treats micropulsation resulting from an ionospheric current system perturbed by conductivity variations resulting from particle bombardment at high latitudes. Recordings of pulsation frequency, auroral radiation, proton and electron absorption, and infrasonic pressure waves, performed at various stations, were mentioned in discussion. Treated in greater detail are the micropulsation propagation from high to low latitudes, and ionospheric propagation ducts. Propagation modes are calculated, and calculated results are compared with experimental data. K.W.

N66-32336*# AeroChem Research Labs., Inc., Princeton, N. J.

STUDIES SUPPORTING AN UPPER-ATMOSPHERE CHEMICAL RELEASE PROGRAM. PART I: EXPERIMENTAL STUDIES ON CHEMILUMINESCENCE. PART II: A MODEL OF RELEASES LEADING TO UPPER-ATMOSPHERIC CHEMION FORMATION Final Report, May 1965-May 1966

A. Fontijn, H. S. Pergament, P. H. Vree, and G. D. Bleich Jun. 1966 62 p refs

(Contract NAS1-5035)

(NASA-CR-66123; TP-137) CFSTI: HC $2.50/MF $0.75 CSCL 04A

Chemiluminescent compounds for studying the upper atmosphere were investigated. The work indicated that diborane, B_2H_6, has unique advantages as a release agent. Diborane's chemiluminescent reactions were compared with those of NO, trimethyl aluminum (TMA), CS_2, and C_2H_2. The intensity of the O-B_2H_6 reaction was close to that of the O-NO reaction but was enhanced by O_2 ground state molecules. TMA had a weak chemiluminescence in its reaction with O atoms but was more intense in reacting with O_2 molecules. The O-C_2H_2 reaction produced a weak chemiluminescence. The O-CS_2 reaction had a high initial intensity but rapidly decreased with distance. An atmospheric model for point chemical releases was developed to test the feasibility of producing observable electron clouds by chemi-ionization reactions. A digital computer program was developed for use with the model. A chemi-ionization reaction mechanism for acetylene releases was developed. Predictions of the electron density profile in space and time following an acetylene release were made and indicate that chemi-ionization can be used to study the upper atmosphere in a manner similar to chemiluminescent observations by optical techniques. R.N.A.

N66-32338# Groupe de Recherches Ionospheriques, Issy-les-Moulineaux (France).

IONOSPHERIC DATA FROM TAMANRASSET, JANUARY 1963 [DONNEES IONOSPHERIQUES DE TAMANRASSET, JANVIER 1963]

[1963] 34 p ref In FRENCH

CFSTI: HC $2.00/MF $0.50

Ionospheric measurements taken at the Tamanrasset station during January 1963 are reported. Tables give frequency characteristics and various altitude characteristics on an hourly basis for each day during the month, according to standard recommended by Ursi for the International Geophysical Year. Median and base values are computed for the various hourly readings, and explanations are presented for all of the symbols used in the tables. Transl. by M.W.R.

N66-32339# Groupe de Recherches Ionospheriques, Issy-les-Moulineaux (France).

IONOSPHERIC DATA FROM TAMANRASSET, FEBRUARY 1963 [DONNEES IONOSPHERIQUES DE TAMANRASSET, FEVRIER 1963]

[1963] 34 p ref In FRENCH For abstract see N66-32338 18-13

CFSTI: HC $2.00/MF $0.50

N66-32340# Groupe de Recherches Ionospheriques, Issy-les-Moulineaux (France).

IONOSPHERIC DATA FROM TAMANRASSET, MARCH 1963 [DONNEES IONOSPHERIQUES DE TAMANRASSET, MARS 1963]

[1963] 34 p ref In FRENCH For abstract see N66-32338 18-13 CFSTI: HC $2.00/MF $0.50

N66-32341# Groupe de Recherches Ionospheriques, Issy-les-Moulineaux (France).

IONOSPHERIC DATA FROM TAMANRASSET, APRIL 1963 [DONNEES IONOSPHERIQUES DE TAMANRASSET, AVRIL 1963]

[1963] 34 p ref In FRENCH For abstract see N66-32338 18-13

CFSTI: HC $2.00/MF $0.50

N66-32342# Groupe de Recherches Ionospheriques, Issy-les-Moulineaux (France).
IONOSPHERIC DATA FROM TAMANRASSET, MAY 1963 [DONNEES IONOSPHERIQUES DE TAMANRASSET, MAI 1963]
[1963] 34 p ref In FRENCH For abstract see N66-32338 18-13
CFSTI: HC $2.00/MF $0.50

N66-32343# Groupe de Recherches Ionospheriques, Issy-les-Moulineaux (France).
IONOSPHERIC DATA FROM TAMANRASSET, JUNE 1963 [DONNEES IONOSPHERIQUE DE TAMANRASSET, JUIN 1963]
[1963] 34 p ref In FRENCH For abstract see N66-32338 18-13
CFSTI: HC $2.00/MF $0.50

N66-32344# Groupe de Recherches Ionospheriques, Issy-les-Moulineaux (France).
IONOSPHERIC DATA FROM TAMANRASSET, SEPTEMBER 1963 [DONNEES IONOSPHERICS DE TAMANRASSET, SEPTEMBRE 1963]
[1963] 34 p ref In FRENCH For abstract see N66-32338 18-13
CFSTI: HC $2.00/MF $0.50

N66-32345# Groupe de Recherches Ionospheriques, Issy-les-Moulineaux (France).
IONOSPHERIC DATA FROM TAMANRASSET, OCTOBER 1963 [DONNEES IONOSPHERIQUES DE TAMANRASSET, OCTOBRE 1963]
[1963] 34 p ref In FRENCH For abstract see N66-32338 18-13
CFSTI: HC $2.00/MF $0.50

N66-32366# Groupe de Recherches Ionospheriques, Issy-les-Moulineaux (France).
IONOSPHERIC DATA FROM GARCHY, SEPTEMBER 1965 [DONNEES IONOSPHERIQUES DE GARCHY, SEPTEMBRE 1965]
[1965] 34 p ref In FRENCH
CFSTI: HC $2.00/MF $0.50

Ionospheric frequency and altitude characteristics are tabulated by the Garchy station (also known as R. P. Lejay) for September 1965. The various tabulations are made on an hourly basis for each of the days during the month, and median and base values are given for each of the hours. Terminology and symbols used in describing the ionospheric characteristics are listed, and standards for making the measurements are given.
Transl. by M.W.R.

N66-32367# Groupe de Recherches Ionospheriques, Issy-les-Moulineaux (France).
IONOSPHERIC DATA OF GARCHY, OCTOBER 1965 [DONNEES IONOSPHERIQUES DE GARCHY, OCTOBRE 1965]
[1965] 34 p ref In FRENCH For abstract see N66-32366 18-13
CFSTI: HC $2.00/MF $0.50

N66-32368# Groupe de Recherches Ionospheriques, Issy-les-Moulineaux (France).
IONOSPHERIC DATA FROM GARCHY, NOVEMBER 1965 [DONNEES IONOSPHERIQUES DE GARCHY NOVEMBRE 1965]
[1965] 34 p ref In FRENCH For abstract see N66-32366 18-13
CFSTI: HC $2.00/MF $0.50

N66-32369# Group de Recherches Ionospheriques Issy-les-Moulineaux (France).
IONOSPHERIC DATA FROM GARCHY, DECEMBER 1965 [DONNEES IONOSPHERIQUES DE GARCHY, DECEMBRE 1965]
[1966] 34 p ref In FRENCH For abstract see N66-32366 18-13
CFSTI: HC $2.00/MF $0.50

N66-32379# Defence Research Telecommunications Establishment, Ottawa (Ontario).
ALOUETTE 1—IONOSPHERIC DATA ALOSYN, 16–30 NOVEMBER 1963
1 Mar. 1966 155 p
CFSTI: HC $3.25/MF $1.00

Alouette topside sounder synoptic data, consisting of selected ionospheric parameters obtained from Alouette I ionograms, are tabulated. The data was recorded in 1963 and the day and time of the observations are included in the listing.
H.S.W.

N66-32380# Defence Research Telecommunications Establishment, Ottawa (Ontario).
ALOUETTE 1—IONOSPHERIC DATA N(h), VOLUME 3, NO. 2
1 Jul. 1966 354 p
CFSTI: HC $4.25/MF $1.75

Tabulations consisting of electron number density profiles for selected groups of ionograms obtained from the Alouette I topside sounder satellite are presented. Because of phenomena which limit the accuracy with which these profiles can be deduced, a quality figure is included in the list which indicates the suitability of an ionogram record for obtaining high quality accuracy data. The methods employed in reducing the data are discussed briefly, and directions are given for accurately using the tables provided. H.S.W.

N66-32387# McGill Univ., Montreal (Quebec). Soil Mechanics Lab.
ON THE STRENGTH OF SOIL UNDER DYNAMIC LOADING
R. N. Yong, R. D. Japp, and H. C. Leitch Jul. 1965 25 p ref Presented at the 5th Meeting Quadripartite Working Group on Ground Mobility, Kingston, Ontario *Its* Soil Mech. Ser. No. 13
(D-PHYS-R-(6)-MISC-20) CFSTI: HC $1.00/MF $0.50

This paper presents an examination of the behavior of a clay soil subjected to dynamic loading. The prediction of ultimate strength with reference to strain rate and consolidation pressure, based upon certain simplifying assumptions has been shown to be described by a relationship defined in terms of a parametric surface. The study has been restricted to the case of a normally consolidated and fully saturated remoulded soil in the interest of maintaining a minimal number of variables. The prediction afforded by the approximate analysis does not attempt to provide a mechanistic for... lation of the response behavior. In the approach to this present analysis specific interactions are considered as demonstrable quantities specifying overall behavior in terms of the parameters defined by the equation. Author

N66-32413# Institut Franco-Allemand de Recherches, St. Louis (France).

IONIZATION PROBES TO MEASURE THE IONIC DENSITY IN THE IONOSPHERE [SONDES D'IONISATION DESTINEES A LA MESURE DE LA DENSITE IONIQUE DANS L'IONOSPHERE]

J. Kaprelian, J. Kuckertz, and M. Laung 6 Dec. 1965 54 p refs In FRENCH

(Contract DRME-540/65)

(ISL-T-22/65) CFSTI: HC $2.50/MF $0.50

Following a historical review of the methods for making ionospheric measurements, the theory of Langmuir sounding and its limitations are outlined. Adaptation of Langmuir probing for measuring ionization in the ionosphere is discussed, and consideration is given to sounding ionic saturation by equipment on a Centaur rocket. The latter is intended to measure ionization in the E layer between 90 and 140 km. Transl. by M.W.R.

N66-32414# Institut Franco-Allemand de Recherches, St. Louis (France).

STUDIES AND PRELIMINARY TESTS FOR THE SIMULATION OF HIGH ALTITUDE EXPLOSIONS. PART II: EXPLOSIONS OF SMALL LEAD NITRIDE SPHERES IN VARIOUS AIR DENSITIES [VORBEREITENDE ARBEITEN UND VORVERSUCHE ZUR SIMULATION VON SPRENGUNGEN IN GROSSEN HOEHEN. TEIL II: SPRENGUNGEN KLEINER BLEIAZIDKUGELN IN VERSCHIEDENER LUFTDICHTE]

M. Froboese 24 Aug. 1965 34 p refs In GERMAN

(ISL-T-29/65) CFSTI: HC $2.00/MF $0.50

Ultra-rapid cinematography is used to study air shock waves produced by the detonation of explosive charges, and space–time diagrams are recorded for different initial pressures. To achieve this, lead nitride spheres weighing 225 mg were detonated at atmospheric pressure, and the pressure was progressively decreased to 3.5 mm Hg. After determining the propagation speed for the shock waves for real and perfect gases, the pressure in front of the shock is deduced. Preliminary results are presented for the detonation of very large spheres of secondary explosives in rarefied atmospheres at different pressures. These measurements are intended to simulate the effects of explosions at different altitudes. Transl. by M.W.R.

N66-32488# Louisiana State Univ., Baton Rouge. Coastal Studies Inst.

INDIAN OCEAN STUDIES. PHYSICAL GEOGRAPHY RECONNAISSANCE: LAS BELA COASTAL PLAIN, WEST PAKISTAN, PART I

Rodman E. Snead 1 Apr. 1966 130 p refs *Its* Contrib.-66-1

(Contract Nonr-1575(03))

(TR-15; AD-633108) CFSTI: HC $4.00/MF $1.00

A geomorphologic description and physical changes which occurred during the quaternary in the Las Bela Valley form the basis of this study. A climatically arid region, broken occasionally by winter and summer rainfall, has resulted with barren landscapes covered only with sparse xerophytic vegetation. Vegetation zonation delineates areas of recent alluvium and beaches from older dunes, gravel fans, and foothills. Enormous sand dunes deposited by southwest winds dominate the east side of the central plain. Crustal displacement associated with Alpine-Himalayan geosynclinal movement has resulted in uplifted alluvium which form terraces 10 feet high in the central plain; tilting of the windblown Pleistocene sands in the east; and faults across the recent beach ridges. Raised oyster beds, barnacles, and wave cut benches are evidence that the sea has invaded the area in past times. The growth of coastal sand spits, changes in the position of mangrove growth in the lagoon, and retreat of the present coast attest to changing environments produced by deposition of the Windar River and wave activity from the sea. Author (TAB)

N66-32490# Air Force Office of Scientific Research, Washington, D. C.

VELA UNIFORM PROGRAM: RESEARCH IN SEISMOLOGY, 1961–1965

Jan. 1965 102 p refs

(AFOSR-65-2667; AD-632453) CFSTI: HC $3.00/MF $0.75

A program of basic research in seismology was carried out to improve the capability to distinguish seismically between nuclear explosions and natural geological events. Research efforts were applied in areas of identification techniques, data processing, array configuration, deep-hole and ocean bottom detection, instrumentation techniques, magnitude-energy scale relationships, noise studies, earth seismicity, explosion and earthquake source mechanism studies, crustal studies, and theoretical studies. This report presents summaries of the accomplishments of those efforts funded to date. The summaries were prepared by grantee and contractor research personnel. TAB

N66-32495# Institute of Modern Languages, Inc., Washington, D. C.

AN INTEGRAL EQUATION OF THE INVERSE PROBLEM OF ELECTRICAL PROSPECTING

A. A. Chudinova Ft. Belvoir, Va., Army Engr. Res. and Develop. Labs., [1960] 11 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zavedenii (Moscow), v. 49, no. 6, 1965 p 150–155

(Contract DA-44-009-AMC-1563(T))

(ERDL-T-1839-66; AD-632674) CFSTI: HC $1.00/MF $0.50

A problem in the theory of logarithmic potential is considered which is a plane case of the inverse problem of electrical prospecting, and an integral equation is evolved for its solution. The properties of the potential of a simple layer are utilized in deriving the equation. The problem is then solved in finite form when the boundary of the desired body is determined by a finite number of parameters satisfying a finite system of equations compiled on the basis of a specified perturbation. M.W.R.

N66-32497# Army Cold Regions Research and Engineering Lab., Hanover, N. H.

ICE COVER OF AN ARCTIC PROGLACIAL LAKE

George K. Swinzow Mar. 1966 51 p refs

(CRREL-RR-155; AD-632987) CFSTI: HC $3.00/MF $0.50

The results are presented of 2 field seasons of research on Lake Tuto, NW Greenland, and the specific thermal environment, forms of ice, conditions of gas exsolution, and special conditions of ice waste are discussed. Special forms of ice and coarse air inclusions called worm bubbles are reported. An observation of ice waste from the upper surface at low temperatures is attributed to a combination of sublimation and abrasion by blowing snow. Temperatures in the 2-m thick ice cover, as well as in water, were observed during ice growth. These and other observations suggest that sunlight is the main heat source and the sun penetration of the ice may raise the water temperatures an appreciable degree. It was found that the lake water contains 3% to 4% gas

while the ice contains 0.5% of dissolved gases of a composition probably differing from that of the air. Existing theories of solute rejection by the moving solid–liquid interface are found inadequate for the case of the ice–water–gas system. It is concluded that worm bubbles may form by a mechanism other than nucleation at the interface. Author (TAB)

N66-32504# Travelers Research Center, Inc., Hartford, Conn.
STUDIES OF TECHNIQUES FOR THE ANALYSIS AND PREDICTION OF TEMPERATURE IN THE OCEAN. PART IV: NUMERICAL FLOW PREDICTION WITH THE EQUIVALENT-BAROTROPIC MODEL Interim Report
James G. Welsh and Geirmundur Arnason Mar. 1966 32 p
(Contract N62306-1675)
(Rept.-7421-208; AD-632294) CFSTI: HC $2.00/MF $0.50

The equivalent-barotropic model is formulated for an ocean with a fixed, uneven bottom and a free surface. The model is applied to predict the two-dimensional, vertically-integrated flow in a channel which includes the Gulf Stream from Cape Hatteras to the Grand Banks. By properly weighting the bottom topography in the model, meander patterns are formed which are similar to those observed. Examples of predictions by the model are shown and the results are discussed. Author (TAB)

N66-32511# Geo-Science, Inc., Alamogordo, N. Mex.
RESEARCH ON AIRGLOW Final Report, 1 Jan. 1961–31 Mar. 1965
June G. Jones and Mark W. Jones 26 Apr. 1965 25 p refs
(Contract AF 19(604)-7992)
(AFCRL-65-310; AD-617083) CFSTI: HC $1.00/MF $0.50

Observations of the night airglow were made at Sacramento Peak, New Mexico, at San Juan, Argentina, and at Tonantzintla, Mexico. The data of the night airglow, received from these stations as well as from Huancayo, Peru, were reduced and tabulated. Calibration techniques for the photometer are described. Special studies of airglow phenomena and special observations of the airglow emissions at twilight with the birefringent filter type photometer and with the night sky spectrograph are discussed. Work on the instrumentation is described. Author (TAB)

N66-32541# National Academy of Sciences—National Research Council, Washington, D. C. Committee on Nuclear Science.
GEOCHRONOLOGY OF NORTH AMERICA
1965 340 p refs *Its* Nucl. Sci. Ser. Rept.-41
(Publ.-1276)

The status of geochronological methods and general rules for data interpretation are discussed. Geochronological data for the North American continent are compiled and tabulations on the precambrian and phanerozoic ages provided. The data include the following: all K-Ar ages except those for feldspars and granitic whole rocks; all Rb-Sr ages except non-isotopic measurements; and all U-Pb and Th-Pb measurements for which complete isotopic data are given. A map showing rock ages in North America is also included. A.G.O.

N66-32575# Joint Publications Research Service, Washington, D. C.
SOVIET-BLOC RESEARCH IN GEOPHYSICS, ASTRONOMY, AND SPACE, NO. 137
2 Aug. 1966 86 p
(JPRS-36-794; TT-61-11147-137) CFSTI: $3.00

Abstracts or summaries of articles gathered from publications of the Sino-Soviet Bloc countries are presented. Subject matter covered includes astronomy, meteorology, oceanography, terrestrial geophysics, and upper atmosphere and space research. Complete bibliographic information accompanies each article. H.S.W.

N66-32579# Bureau of Mines, Washington, D. C.
TITANIUM RESOURCES OF THE UNITED STATES
Edward C. Peterson 1966 80 p refs
(BM-IC-8290) GPO: $0.40

Recent studies indicate that the United States has substantial reserves of ilmenite, one of the major titanium minerals. However, the studies showed that sources of rutile, another important source of titanium are limited. This paper summarizes and evaluates results and conclusions reached by the various investigations initiated by the Bureau of Mines and others pertaining to the titanium mineral resources of the Nation. Domestic occurrences of ilmenite that are economically exploitable by present-day beneficiation methods are found in Florida, New Jersey, New York, South Carolina, and Virginia. These deposits are estimated to contain 50.3 million tons of titanium dioxide (TiO_2). Occurrences of ilmenite that cannot be processed economically under present technological conditions are found in California, Colorado, Minnesota, Montana, Oklahoma, Oregon, Rhode Island, and Wyoming. These reserves amount to 51.1 million tons of TiO_2. Reserves of rutile found in the United States are estimated to be 1.8 to 2.1 million tons of TiO_2. Other than occurrences in Florida and South Carolina, rutile is found either in small scattered bodies or in deposits where the mineral cannot be recovered economically by present beneficiation methods. Author

N66-32583# Alaska Univ., College. Geophysical Inst.
TRACKING THE AURORA BY A MULTIFREQUENCY HF BACKSCATTER SOUNDER
Howard F. Bates, Albert E. Belon, Gerald J. Romick, and William J. Stringer Oct. 1965 28 p refs
(Grants NSF GP-947; NSF GP-2721)
(UAG-R-169)

A comparison of simultaneous optical and radio auroral data obtained during 12 days in December, 1964, shows conclusively that the radio wave scattering belt includes the visual auroral belt. The optical data were obtained with the Alaskan network of all-sky-cameras located between 65 and 80° north geomagnetic latitude. With the exception of vertical incidence, meteor, groundscatter, and slant F (polar spur) traces, all of the recorded backscatter traces from the north were scaled indiscriminately for slant range. The excellent agreement that resulted leads us to conclude that the majority of the HF and low VHF backscatter echoes observed at high latitudes are auroral echoes in the strict sense of the term. In the records shown the auroral belt was tracked from 65 to above 80° N geomagnetic latitude. It is concluded that the multifrequency HF backscatter sounder makes year-round observations of the auroral belt possible. Author

N66-32601# Joint Publications Research Service, Washington, D. C.
MAGNETIC FIELDS OF MARINE TELLURIC CURRENTS
G. A. Fonarev and V. I. Ivanov 2 Aug. 1966 14 p refs
Transl. into ENGLISH from Geomagnetizm i Aeronomiya (Moscow), v. 6, no. 3, May–Jun. 1966 p 544–547
(JPRS-36786; TT-66-33217) CFSTI: $1.00

In this paper the authors consider the problem of magnetic fields created by telluric currents in the ocean. A two-layer magnetotelluric model is used. It is shown that for the short-period pulsations observed at the surface of the ocean the magnetic field of the electrical currents in the water is equal to the primary magnetic field. This is confirmed by experimental data obtained on the drifting station SP-10. For long-period variations of the diurnal and semidiurnal type the magnetic field of these currents constitutes 7–15% of the total field. Author

14 INSTRUMENTATION AND PHOTOGRAPHY

Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gages; recorders; transducers; aerial photography; and telescopes and cameras.

N66-31432*# General Electric Co., Daytona Beach, Fla. Apollo Support Dept.
LEAKAGE DETECTION AND MEASUREMENT
R. I. Ceder-Brown *In* NASA. Marshall Space Flight Center Proc. of the Conf. on the Design of Leak-Tight Fluid Connectors [1965] p 89–97 (See N66-31420 18-15) CFSTI: HC $6.00/MF $1.25

The sensors discussed are divided into three groups for specific gas applications: (1) hydrogen sensors, (2) oxygen sensors, and (3) non-specific sensing methods. The discussion of the sensors presents general characteristics of commercially available sensors and is followed by scope of work on recent research and developments in leak detection. Author

N66-31480*# Harvard Univ., Cambridge, Mass.
HIGH-RESOLUTION PLANETARY PHOTOGRAPHY AND THE DETECTION OF LIFE
Carl Sagan *In* Calif. Inst. of Tech. Proc. of the Caltech–JPL Lunar and Planetary Conf. 15 Jun. 1966 p 279–287 refs (See N66-31446 18-30) CFSTI: HC $7.00/MF $1.85

This paper discusses the use of high resolution photography to detect extraterrestrial life. It is shown that the detection of life, even on earth, is difficult with the photographic systems of the Nimbus and Tiros satellites. Photographs from these satellites, with few exceptions, show no signs of civilization. Mariner IV's photographs of Mars, although of higher resolution than those of Nimbus or Tiros, neither demonstrated nor precluded the possibility of life on Mars. However, the high resolution photographic system on military reconnaissance satellites have demonstrated that the detection of life, at least on earth, is feasible at orbital altitudes. Examples of Nimbus, Tiros, and military reconnaissance satellite photographs are shown. R.N.A.

N66-31485*# Boeing Co., Huntsville, Ala. Launch Systems Branch
RESEARCH ON PASSIVE INSTRUMENTATION AND STIMULI GENERATION FOR SATURN IB EQUIPMENT CHECKOUT. VOLUME II: DETAILED TECHNICAL REPORT
Final Report, 26 Jun. 1965–31 May 1966
Henry N. Kaushagen and Kenneth L. Skinner 31 May 1966 311 p refs
(Contract NAS8-20090)
(NASA-CR-76403; D5-13268-2) CFSTI: HC $7.00/MF $1.75 CSCL 22D

An extensive investigation of passive instrumentation techniques, and methods of application to the Saturn IB Instrument Unit was conducted. The appropriate passive techniques, the types of components that the techniques should be adapted to, and the stimuli generation and response evaluation equipment are defined; and the methods of coupling into and out of a component or a system are determined. The feasibility of applying passive instrumentation to the measurement of magnetic, electrical, infrared, heat, optical, luminescent, nuclear, X-ray, chemical, mechanical, and acoustical phenomena are discussed; and laboratory experiments to this end were conducted. Application experiments described include the use of Hall effect stimulus, magnetoresistance stimulus, optoelectronic, resonant beam flowmeter, ultrasonic flowmeter, and photon coupled stimulus equipment. L.S.

N66-31564# Army Electronics Labs., Fort Monmouth, N. J.
A MECHANICAL SHOCK PULSE SURVEY
Francesco Palmisano *In* NRL The Shock and Vibration Bull. No. 35, Pt. 6 Apr. 1966 p 209–227 refs (See N66-31546 18-32) CFSTI: HC $7.00/MF $1.75

A survey of the shock pulse shapes produced by eight mechanical shock machines used in the evaluation of electronic piece parts is discussed. The shock machines include the general types of free-fall, pendulum, and cam-activated. The shock pulses range in nominal time duration of from 40 to 1150 g. Author

N66-31582# Joint Publications Research Service, Washington, D. C.
IMAGE AMPLIFIER FOR THE UEMV-100 ELECTRON MICROSCOPE
I. F. Anaskin, I. G. Stoyanova, B. L. Kozlov, and V. F. Semenov *In its* Electron Microscopy and Mat. Studies 23 Jun. 1966 p 59–63 (See N66-31575 18-26) CFSTI: $3.00

The feasibility of using a television amplifier and an image orthicon to amplify an electron microscope image was investigated. In comparing the television amplifier-image orthicon system with a vidicon system, the former requires no design changes in the electron microscope while the latter does. The system containing the image orthicon has a more reliable and stable operation. When an image orthicon is used in a system which has a high sensitivity, there is a considerable increase in the electron microscope image amplifier sensitivity and the imaged flashed on the electron microscope screen is seen when the electron density is 10^{-14} a/cm^2. A television amplifier with an electron optical light converter was also investigated. This system has a sensitivity an order greater than the image orthicon system, but this gain is accompanied by a reduction in image quality. R.N.A.

N66-31612# Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Lab. Nazionali di Frascati.
A MAGNETIC DETECTOR FOR ADONE
G. K. O'Neill (Stanford Univ.) 1 Apr. 1966 24 p refs *Its* Internal Note No. 317
(LNF-66/18) CFSTI: HC $1.00/MF $0.50

This paper discusses the design criteria for an all-purpose magnetic detector capable of detecting all known particles produced in two-particle reactions. By energy conservation the

momentum resolution of the apparatus will be adequate for studying more complicated multi-body reactions. Error calculations in momentum measurement, scaling laws for magnet size, magnet geometry, spark chambers and photography, choice between conventional and cryogenic coils, analysis background, trigger counters and rates, and cost are considered. R.N.A.

N66-31643# Argonne National Lab., Ill.
AN INDUCTION PROBE FOR MEASURING LIQUID LEVELS IN LIQUID METALS
T. R. Johnson, F. G. Teats, and R. D. Pierce Feb. 1966 28 p refs
(Contract W-31-109-ENG-38)
(ANL-7153) CFSTI: $2.00

A mutual-inductance probe has been developed to determine the location of the interface between gas and liquid metal and between liquid salt and liquid metal. The probe is a bifilar winding of Nichrome wire on an alumina form contained in stainless steel or a ceramic well. A high-frequency voltage supplied to one winding induces a voltage in the second winding, that can be related to the depth of liquid surrounding the coil. Probes, approximately 5 and 14 in. long, have been calibrated in liquid cadmium, bismuth, and sodium over the range from 200 to 700°C. The output signal was only slightly affected by the metal resistivity over the range from 20 to 140 μohm-cm. The response was influenced by the temperature of the probe. A simplified procedure for calibrating the probe is discussed. Author

N66-31651# Aerospace Research Labs., Wright-Patterson AFB, Ohio.
PHOTOELECTRIC PHOTOMETRY—A NEW TOOL FOR SATELLITE SIGNATURES
Kenneth E. Kissell *In* Office of Aerospace Res. Proc. of the OAR Res. Appl. Conf. [1966] p 71–99 refs (See N66-31646 18-34) CFSTI: HC $5.00/MF $1.00

The experience gained since 1962 in the photoelectric measurement of space vehicle brightness is outlined, and the methods used to collect signature data on vehicles of brightness +11 stellar magnitudes (1/50 m^2 diffuse scatterer at 1000 km) or greater are described. Examples of light curves are given, and a model of a tumbling, diffusely scattering cylinder is compared with a USSR rocket body. A model of a specularly scattering sphere is compared with data collected from three USSR vehicles whose orbital lifetimes indicated their being of de-orbiting character. It is shown that these techniques offer a relatively low-cost method of collecting optical signature data at ranges much exceeding those at which resolved images could be obtained. The bistatic and CW character of the technique is demonstrated, which, combined with its inherent inverse-square law limitation on slant range, suggests it as a valuable supplement to conventional radar techniques and long focus imaging for the purpose of identifying the external characteristics of satellites. Author

N66-31656# Stanford Univ., Calif. Dept. of Physics.
FROM QUANTIZED FLUX TO A FREE PRECESSION NUCLEAR GYRO
William M. Fairback, William O. Hamilton, and C. W. F. Everitt *In* Office of Aerospace Res. Proc. of the OAR Res. Appl. Conf. [1966] p 153–172 refs Sponsored by NASA, AFOSR, NSF, ONR, and AROD (See N66-31646 18-34) CFSTI: HC $5.00/MF $1.00

A description is given of research which has led to a new understanding of quantized flux in a superconducting ring. These studies in low temperature physics have made possible in principle a more sensitive magnetometer, and a truly zero magnetic field region inside a perfect magnetic shield. Also, a gyroscope capable of checking Einstein's general theory of relativity in a satellite experiment, and a completely new kind of guidance instrument, a free precession nuclear gyro was developed. This gyro makes possible a test of time reversal invariance, one of the fundamental symmetry laws of physics now under question. C.T.C.

N66-31677*# General Electric Co., Cincinnati, Ohio. Re-Entry Systems Dept.
DEVELOPMENT OF EFFLUX MEASURING DEVICE FOR PERFORMANCE EVALUATION OF POTASSIUM VAPOR TURBINE
G. C. Wesling, R. J. Rossbach, and W. M. Shaffernocker *In* Argonne Natl. Lab. Proc. of the Conf. on Appl. of High Temp. Instrumentation to Liquid-Metal Expt. [1965] p 127–164 refs (See N66-31671 18-33) CFSTI: HC $6.75/MF $3.25
(Contract NAS5-1143)

The development of a device, to measure total and static pressures at inlet and outlet and static pressures before and after blade rows in a turbine having flow passages no higher than one inch, is reported. The design of the efflux measuring device is based on the flowing of a metered amount of an inert gas through the sensor lines into the test facility. This flow prevents the diffusion of potassium vapor into the sensor lines, and thus pressure transducers which operate in an inert gas, moderate temperature environment can be used. The device was used to measure the pressures and also potassium vapor flow rates in the 200-horsepower turbine. It was concluded that the efflux system compared favorably with that of the limp diaphragm pressure transducer, and that good results were obtained in measuring turbine pressures, flow rates, and efficiency. N.E.N.

N66-31678*# Consolidated Controls Corp., Bethel, Conn.
PRESSURE TRANSDUCER FOR LIQUID METAL APPLICATIONS
Anthony J. Cassano and Richard E. Engdahl *In* Argonne Natl. Lab. Proc. of the Conf. on Appl. of High Temp. Instrumentation to Liquid-Metal Expt. [1965] p 165–186 refs (See N66-31671 18-33) CFSTI: HC $6.75/MF $3.25
(Contract NAS3-4170)

The development of a pressure transducer providing accurate measurements in the liquid, vapor, and two-phase streams of a potassium loop operating at temperatures up to 1800°F is discussed. In addition to potassium, the transducer may also find use in loops containing sodium, lithium, cesium or rubidium. The transducer employs a thermionic diode sensor to convert the motion of a pressure-actuated refractory alloy capsule into a suitable electrical output. Author

N66-31681*# Michigan Univ., Ann Arbor. Liquid Metals Lab.
INSTRUMENTATION FOR TWO PHASE METALLIC FLOWS
Richard E. Balzhiser and Lowell R. Smith (Pan Am. Petrol. Co., Tulsa, Okla.) *In* Argonne Natl. Lab. Proc. of the Conf. on Appl. of High Temp. Instrumentation to Liquid-Metal Expt. [1965] p 217–245 refs (See N66-31671 18-33) CFSTI: HC $6.75/MF $3.25
(Contracts AF 33(616)-8277; AF 33(657)-11548)

Instrumentation for measuring pressure drop and void fractions in two phase metallic flows is discussed. A Taylor

differential pressure gage was used to measure pressure drop over a 36-inch length of horizontal .495-inch tubing. Void fractions were determined at the center of this section using radiation attenuation techniques. A thulium 170 source is used to provide a 0.084 MeV gamma ray for measurement purposes. A thallium activated NaI crystal is used for detection of the essentially monoenergetic beam. Problems in alignment at loop temperatures are cited as well as the importance of temperature control of the scintillator. The range of applicability for such measurements and results obtained will be discussed. Author

N66-31682*# North Carolina State Coll., Raleigh. Dept. of Chemical Engineering.

AN ACCURATE ONE-SHOT GAMMA ATTENUATION TECHNIQUE FOR MEASURING VOID FRACTIONS

J. K. Ferrell and John W. Mc Gee *In* Argonne Natl. Lab. Proc. of the Conf. on Appl. of High Temp. Instrumentation to Liquid-Metal Expt. [1965] p 247–269 refs (See N66-31671 18-33) CFSTI: HC $6.75/MF $3.25

The one-shot gamma attenuation technique for measuring local void volume fraction of two-phase fluids in small flow channels was investigated to obtain improved accuracy by eliminating the dependence of the measurements on the void distribution in the flow channel. The criterion for the design of a one-shot collimator, and the design are discussed. The void fractions of a number of Lucite models, of a variety of shapes, were measured. The electronic equipment is described, and the results are presented in tabular and graph form. It was concluded that the collimator shape greatly affects the dependence of the void fraction measurements on the void distribution, and that the criterion developed will provide accurate measurements independent of the void distribution. N.E.N.

N66-31683*# Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.

DEVELOPMENT OF ALKALI METAL QUALITY METER

Peter Tauson and R. L. Ammon *In* Argonne Natl. Lab. Proc. of the Conf. on Appl. of High Temp. Instrumentation to Liquid-Metal Expt. [1965] p 271–287 (See N66-31671 18-33) CFSTI: HC $6.75/MF $3.25
(Contract AF 33(615)-2495)

A calorimeter to analyze the alkal metal vapor in a turbogenerator for its liquid content is described. The theoretical concepts are discussed, and an expression is developed for the quality of the vapor in terms of measurable values of temperature increments and heat input. Details on the design, material selection, and construction are presented. The estimated errors in measurements and in thermodynamic parameter are indicated. N.E.N.

N66-31684*# Battelle Memorial Inst., Columbus, Ohio.

LIQUID-METAL LUBRICATED BEARING INSTRUMENTATION

D. R. Grieser and J. L. Morris (AF Aero Propulsion Lab.) *In* Argonne Natl. Lab. Proc. of the Conf. on Appl. of High Temp. Instrumentation to Liquid-Metal Expt. [1965] p 291–306 (See N66-31671 18-33) CFSTI: HC $6.75/MF $3.25
(Contract AF 33(615)-2812)

Progress is reported in the development of miniaturized transducers to measure lubricant behavior in fluid film bearings for the high speed turbine rotating elements. An eddy current/inductance technique was selected for film thickness measurement and film continuity detection. A technique based on the Villari effect was chosen for film pressure measurement. Bench simulation studies were made on preliminary transducer models, and analytical studies were performed. Details on the transducer development and experimental studies are given. N.E.N.

N66-31685*# AiResearch Mfg. Co., Phoenix, Ariz.

DEVELOPMENT OF PERFORMANCE-MEASURING INSTRUMENTATION FOR A LIQUID-METAL TURBINE-DRIVEN BEARING TEST RIG

L. W. Stillwell and R. Herman *In* Argonne Natl. Lab. Proc. of the Conf. on Appl. of High Temp. Instrumentation to Liquid-Metal Expt. [1965] p 307–329 (See N66-31671 18-33) CFSTI: HC $6.75/MF $3.25

The design, development and calibration of a film thickness transducer, based on eddy currents, are reported. The transducer is calibrated on a special journal bearing test rig with liquid potassium and conventional fluids as lubricants. Details are given on the transducer and on the calibration rig. The transducer calibration was performed in two steps: (1) with no shaft rotary motion, accomplished by stabilizing the rig at a certain temperature and shifting the location of the simulated turbine shaft radially; and (2) with the shaft rotated at various speeds up to 25,000 rpm and the rig stabilized at 250° F. The performance is discussed with respect to the calibration rig, the bearing test loop, and the bearing configurations. N.E.N.

N66-31686*# Mechanical Technology, Inc., Latham, N. Y.

APPROACHES TO THE MEASUREMENT OF THE STEADY STATE AND DYNAMIC PERFORMANCE CHARACTERISTICS OF LIQUID-METAL LUBRICATED BEARINGS

E. B. Arwas, F. K. Orcutt, and B. Sternlight *In* Argonne Natl. Lab. Proc. of the Conf. on Appl. of High Temp. Instrumentation to Liquid-Metal Expt. [1965] p 331–364 refs (See N66-31671 18-33) CFSTI: HC $6.75/MF $3.25
(Contracts NASw-771; NASw-1021; AT(30-1)-3363)

This paper presents a discussion of the instrumentation necessary for fundamental investigations, as well as for bearing development and for monitoring of bearing performance in turbomachinery. It points out through examples, that considerable advances applicable to liquid metal lubrication can be accomplished with easy to use fluids that simulate some of the important properties of liquid metals and making use of instrumentation that is already developed. Indirect measurements which, in conjunction with accepted theoretical relations, provide meaningful interpretation of bearing performance are also discussed. Author

N66-31687*# AiResearch Mfg. Co., Phoenix, Ariz.

LIQUID-METAL LEVEL DETECTOR AND INDICATOR

L. W. Stillwell *In* Argonne Natl. Lab. Proc. of the Conf. on Appl. of High Temp. Instrumentation to Liquid-Metal Expt. [1965] p 367–378 (See N66-31671 18-33) CFSTI: HC $6.75/MF $3.25

The design, development, and operation of two types of liquid metal position indicators are described. These detectors are: (1) a portable, manually operated detector for checking shipping containers, locating freeze or oxide plugs in piping, and other uses where a continuous readout is not required, and (2) a permanently mounted, automatic detector used to determine the level of liquid metal wherever a continuous readout is required. The electrical and mechanical descriptions of the eddy current-based automatic detector are reported. The modifications for the manual detector are indicated. N.E.N.

N66-31688*# Oak Ridge National Lab., Tenn.
EXPERIENCES AND DEVELOPMENTS IN INSTRUMENTATION FOR LIQUID METAL EXPERIMENTS
H. J. Metz and M. M. Yarosh *In* Argonne Natl. Lab. Proc. of the Conf. on Appl. of High Temp. Instrumentation to Liquid-Metal Expt. [1965] p 379–412 refs Sponsored by AEC (See N66-31671 18-33) CFSTI: HC $6.75/MF $3.25

A large and complex liquid potassium power generation system and its attendant instrumentation are described. Operating experience with the instruments is outlined, including the instrument location for pressure measurements and temperature measurement using infrared photography. Liquid level determinations are emphasized. Schematics are presented of the manometers and the level measuring elements, and their locations and accuracies are discussed. The characteristics of the differential pressure transmitters are listed. Precautions taken with the gauge pressure transmitters are mentioned. The advantages of having microphones on the boiler, system pumps, and turbopump unit are reported. The difficulties encountered in trying to measure the rpm of the turbines and pumps are described. N.E.N.

N66-31690*# United Nuclear Corp., White Plains, N. Y.
THE LIQUID METAL OXYGEN METER
B. Minushkin *In* Argonne Natl. Lab. Proc. of the Conf. on Appl. of High Temp. Instrumentation to Liquid-Metal Expt. [1965] p 427–441 (See N66-31671 18-33) CFSTI: HC $6.75/MF $3.25
(Contract AT(30-1)-2877)
(UNC-SPLM-61)

The on-line instrument for continuously measuring the effective oxygen content in liquid metals consists of two components, a sensor and indicator. The key elements in the sensor electrode assembly are a solid electrolyte, and a thoria–yttria tube with a copper–copper oxide reference electrode. The sensor is installed in a main or bypass line of the liquid metal system. The indicator, which measures the voltage developed by the sensor, is located either adjacent to the sensor or in the system control center. It is a specially designed differential voltmeter with a very high input impedance. The performance characteristics are discussed, and it is pointed out that calibration is necessary to measure absolute values of oxygen concentrations. A plot of the logarithm of oxygen concentration versus cell emf yields a straight line. The response to changes in cold trap temperature, and the response to additions of oxygen are graphed. The temperature coefficients for the oxygen meter were measured by observing voltage versus cell temperature at constant cold trap temperature, and the results are tabulated. N.E.N.

N66-31691*# United Nuclear Corp., White Plains, N. Y.
AN INERT GAS PURITY TESTER
J. Mc Kee *In* Argonne Natl. Lab. Proc. of the Conf. on Appl. of High Temp. Instrumentation to Liquid-Metal Expt. [1965] p 443–453 (See N66-31671 18-33) CFSTI: HC $6.75/MF $3.25
(UNC-SPLM-63)

An instrument for measuring inert gas purity in glove box operations encountered in handling alkali metals is described. The instrument consists of a filament changer inside the glove box, and a control unit. The changer supports a hot wire titanium filament which is consumed by oxidizing impurities in the gas, and its life is a measure of the total concentration of the impurities. The control unit supplies essentially constant 60 cps current to the filament, and may be adjusted for testing either helium or argon. The calibration procedures are presented, and the reproducibility is discussed. N.E.N.

N66-31692*# Hydronautics, Inc., Laurel, Md. Materials Div.
INSTRUMENTATION FOR EVALUATING CAVITATION DAMAGE RESISTANCE AND HIGH FREQUENCY FATIGUE OF REFRACTORY ALLOYS IN HIGH TEMPERATURE LIQUID ALKALI METALS
H. S. Preiser and A. Thiruvengadam *In* Argonne Natl. Lab. Proc. of the Conf. on Appl. of High Temp. Instrumentation to Liquid-Metal Expt. [1965] p 455–479 refs (See N66-31671 18-33) CFSTI: HC $6.75/MF $3.25
(Contract NAS3-4172)

The design and function of the magnetostriction device and of its components are described. The system consists of a nickel transducer element which contracts in length under the influence of a magnetic field. A velocity transformer is used to amplify the vibratory motion from the transducer. Equipment details are given on the transducer, velocity transformer, amplifier, audio oscillator, and pick-up coil. Calibration of the assembly is discussed, and characteristics of the transducer are graphed. The standardization of test procedures for cavitation damage is mentioned. The use of the magnetostriction apparatus in conducting high frequency fatigue tests was extended to high temperatures in liquid metal environments up to 1500°F. The basic principles of the design are presented, and the unwanted side effects of fatigue notch sensitivity and change in resonant frequency are discussed. Typical test results are included. It was concluded that the device was useful in evaluating the cavitation damage resistance and the fatigue behavior of high temperature alloys in liquid sodium. N.E.N.

N66-31700*# Atomics International, Canoga Park, Calif.
HIGH TEMPERATURE LIQUID METAL INSTRUMENTATION AT ATOMICS INTERNATIONAL FOR: (1) THE SNAP 10A FLIGHT SYSTEM, (2) BOILER CONDITIONING EXPERIMENTS AND MERCURY VAPOR QUALITY MEASUREMENT FOR MERCURY RANKINE SYSTEMS
H. H. Hanlin *In* Argonne Natl. Lab. Proc. of the Conf. on Appl. of High Temp. Instrumentation to Liquid-Metal Expt. [1965] p 641–665 refs (See N66-31671 18-33) CFSTI: HC $6.75/MF $3.25

The lightweight instrumentation, capable of withstanding launch shock and vibration, and developed to monitor NaK flow rate, pressure, and temperature is discussed. Details are given on the instruments and operation, and their characteristics and flight data are graphed. A proposed method of determining mercury vapor quality by using vapor radiation density detectors, and their calibration are presented. A study program is described which consists of pool boiling experiments to determine the relation between wetting and heat transfer characteristics and to determine factors influencing wetting. N.E.N.

N66-31701*# Aerojet-General Aerometrics, San Ramon, Calif.
DEVICE FOR MEASURING THE TEMPERATURE OF LIQUID AND GASEOUS HYDROGEN Final Report
H. C. Chandon and A. R. Larson Apr. 1966 151 p *Its* Rept-0700:1161
(NAS8-11862)
(NASA-CR-76417) CFSTI: HC $3.25/MF $1.00 CSCL 20M

A cryogenic temperature transducer which is extremely fast in response to changing temperature, has medium accuracy, and measures temperature over a wide range, was developed. A schematic diagram of the operational transducer set-up is depicted. The transducer will respond to a temperature change from −246° C to −196° C in 0.1 seconds. An accuracy of 0.3° C is typical over the −253° C to −190° C span when cycled between ambient and cryogenic temperatures repeatedly.

The range of the instrument is designed for −253°C to 60°C. The shaped output curve of the transducer has a very high sensitivity in the liquid hydrogen range and low sensitivity over the remaining temperature span. Typical sensitivity at liquid hydrogen is 1.35 mv/°C. The output signal is also adequate for most recording systems, typically 20 mv at +60°C and 60 mv at −253°C. Thirteen production transducers were fabricated, tested, and delivered. A table of the output signal of these 13 transducers is given. L.S.

N66-31711# Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati.

CRYOSTAT FOR SOLID DEUTERIUM TARGETS [CRIOSTATO PER BERSAGLI DI DEUTERIO SOLIDO]

A. Cecchini and I. Modena 24 Jan. 1966 10 p refs In ITALIAN *Its* Note 303
(LNF-66/2)

The design and performance of a cryostat for solid deuterium targets to be used in plasma studies are described in some detail. Cross sections of the cryostat show the simplicity of its operation. NSA

N66-31760# Rocky Flats Div., Dow Chemical Co., Golden, Colo.

EVALUATION OF DIRECT READING ATTACHMENT FOR EMISSION SPECTROGRAPH

H. V. Barton and E. Vejvoda 21 Apr. 1966 43 p refs
(Contract AT(29-1)-1106)
(RFP-644) CFSTI: HC $2.00/MF $0.50

A photoelectric recording (direct reading) attachment for a 3.4-meter Ebert emission spectrograph is described and evaluated. Relationships and constants describing excitation, photographic recording, photoelectric recording, and optical alignment were determined. Impurity analysis of PuO_2 and U_3O_8 with direct reading by a carrier distillation method is also described. Author (NSA)

N66-31783# Ferranti, Ltd., Edinburgh (Scotland). Flight Trials Dept.

THE MEASUREMENT OF THE HEIGHT OF A LOW FLYING AIRCRAFT

K. R. Mac Kenzie [1966] 33 p refs Presented at 4th Intern. Aerospace Instrumentation Symp., Cranfield, England, 21–24 Mar. 1966
(EIST/INST/52) CFSTI: HC $2.00/MF $0.50

Four different methods of determining the height of a low flying aircraft, as related to terrain clearance radar development trials, are presented. The measurement techniques discussed and tested include radio and radar altimeters, atmospheric pressure measurement, optical measurement of ground features, and mathematical integration of vertical velocity of double integration of acceleration. The results of a trial flight were summarized by plotting the flight path above a cross section of the terrain identified by the vertical camera. Figures showing sections of the trace recording and the reconstructed track of the aircraft illustrate the technique used and some of the problems experienced. The results are discussed in detail, and it was concluded that the optical techniques yield the most accurate measurements. L.E.W.

N66-31832# Production Group, United Kingdom Atomic Energy Authority, Annon (Scotland).

THE APPLICATION OF CONDENSED STATE TECHNIQUES TO NEUTRON DOSIMETRY

D. E. Watt 1966 26 p refs Presented at the Symp. on Dose Measurement Tech. Under Develop., Middlesex Hospital Med. School, London, 15 Feb. 1966
(P6-711(CC)) HMSO: 4s

There are three general approaches to dose measurement in a neutron radiation field. In this paper, a review of the various types of solid and liquid neutron dosimeters under development is presented. The application and range of sensitivity within the three general categories are considered and summarized in a table. A full list of references to relevant work is provided. Author

N66-31833# Royal Observatory, Edinburgh (Scotland).

AN AUTOMATIC MICROPHOTOMETER. A SEMI-AUTOMATIC IRIS PHOTOMETER

H. Seddon and W. Jones [1966] 30 p refs *Its* Publ. of the Roy. Obs., Vol. 5, No. 6 and 7
CFSTI: HC $2.00/MF $0.50

CONTENTS:

1. AN AUTOMATIC MICROPHOTOMETER H. Seddon p 89–97 ref
2. A SEMI-AUTOMATIC IRIS PHOTOMETER H. Seddon and W. Jones p 99–109 refs

N66-31835# College of Aeronautics, Cranfield (England).

THE APPLICATION OF HOT-FILM GAUGES TO THE DETECTION OF BOUNDARY-LAYER TRANSITION IN FLIGHT

M. Gaster Jan. 1966 16 p refs
(CoA-AERO-189) CFSTI: HC $1.00/MF $0.50

A detailed description of the construction of small hot-film gauges is given with an account of the application of these instruments to the specific problem of detecting boundary layer transition in flight. Typical oscilloscope records of gauge signals from experiments on a swept laminar flow wing are reproduced. Author

N66-31856*# Atlantic Research Corp., Alexandria, Va.

A THERMISTOR ARRANGEMENT TO IMPROVE TEMPERATURE MEASUREMENTS AT HIGH ALTITUDES

William A. Drews Washington, NASA, Aug. 1966 53 p ref
(Contract NAS1-1611)
(NASA-CR-533) CFSTI: HC $2.00/MF $0.50 CSCL 20M

A design configuration has been developed for supporting the 0.010 inch diameter bead thermistor. This sensor is routinely employed as an immersion thermometer to measure the air temperature over the approximate altitude interval 30 to 65 kilometers. Theory indicates that devices having physical properties similar to those of the bead thermistor can be used to obtain accurate temperature data up to the region of 65 kilometers. The development described attempts to achieve thermal isolation of the thermistor so that theoretical capability can be realized in practice. Author

N66-31861*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

COPPER MAGNETORESISTANCE DEVICES AS MAGNETOMETERS

Wayne R. Hudson Washington, NASA, Aug. 1966 13 p refs
(NASA-TN-D-3536) CFSTI: HC $1.00/MF $0.50 CSCL 14B

An experimental investigation was initiated to select the most desirable combination of wire diameter and resistance ratio for use as a copper magnetoresistance magnetometer.

Eight different polycrystalline copper wire samples were investigated; the diameters of the samples ranged from 25.4×10^{-6} to 254×10^{-6} meter, and their resistance ratios ranged from 59.5 to 1005. The resistances of the samples were measured over the temperature span of 4.2° to 30°K and in magnetic fields up to 11.5 teslas. The samples were compared on the bases of the changes in ordinary resistance and magnetoresistance over the temperature range. Polycrystalline copper displayed several desirable magnetometer properties. The magnetoresistance changed linearly with increasing magnetic field above a certain minimum field value that depended on the resistance ratio of the sample. The resistance of the lower-resistance-ratio copper samples was constant in the range from 4.2° to 15°K. The magnetoresistance of all the samples tested was independent of temperature from 4.2° to 20°K. Of the samples tested, the 25.4×10^{-6}-meter-diameter sample with a resistance ratio of 155 was selected as having the best combination of desirable characteristics for general use. Author

N66-31867# Polish Academy of Sciences, Cracow. Inst. of Nuclear Physics.
AUTOMATION OF THE MOESSBAUER SPECTROMETER [AUTOMATYZACJA MOESSBAUEROWSKIEGO SPEKTROMETRU]
Jozef Bara and Mieczyslaw Janicki Feb. 1966 14 p ref Submitted for Publication
(Rept.-457/PL) CFSTI: HC $1.00/MF $0.50

The prototype system was elaborated for automatic measurement of the Mössbauer spectra in the velocity range 0–10 mm/sec. This system changes the velocity of the absorber step by step, and records the number of pulses, the time of measurement, and the values of the velocity. The velocity intervals and number of pulses for each point of measurement can be programmed. Author

N66-31929*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AN EXPANSION OF THE EV SYSTEM
W. F. Lindsey [1965] 13 p refs Presented at the 10th Ann. Tech. Symp. of the Soc. of Photo-Opt. Instr. Engr., San Francisco, 16–20 Aug. 1965
(NASA-TM-X-57747) CFSTI: HC $1.00/MF $0.50 CSCL 14E

The exposure value system or additive value system has been expanded to include filter factors and transmittance. In addition, the equations for photoflash and electronic flash photography are converted into a form compatible with the EV system. The photographic factors are presented in tabular form together with their corresponding values in the additive value system in 25-percent steps or quarter stops to permit an acceptable solution to be obtained more readily. Author

N66-31935*# IIT Research Inst., Chicago, Ill.
A FAST-NEUTRON SPECTROMETER OF ADVANCED DESIGN Final Report, 3 May 1965–3 Feb. 1966
Robert B. Moler 11 Apr. 1966 76 p refs
(Contract NAS8-11885)
(NASA-CR-76535) CFSTI: HC $2.50/MF $0.75 CSCL 18D

A prototype fast-neutron spectrometer based on a unique combination of solid-state detectors and He^3-filled proportional counters was developed. The instrument demonstrated a resolution of better than 100 keV and an efficiency of 2×10^{-6}/neutron over the energy range of 0.3 to 3 MeV. Gamma rejection of a high order was demonstrated. The basic system consists of two silicon solid-state detectors separated by two proportional counters. Coincidence between the proportional counters is required. Particle identification is employed to improve gamma rejection and reduce other sources of background. Author

N66-31965# Technische Hochschule Carolo Wilhelmina, Brunswick (West Germany). Fakultaet fuer Maschinenwesen.
CRITICAL COMPARISON OF SEVERAL METHODS FOR MEASURING MACH NUMBER DURING FLIGHT OF ROCKET VEHICLES [KRITISCHER VERGLEICH EINIGER MACHZAHL MESSMETHODEN FUER DEN FREIFLUG VON FERNRAKETEN]
Gerhard H. R. Reisig (Ph.D. Thesis) 1964 154 p refs In GERMAN
CFSTI: HC $3.25/MF $1.00

Acoustic wave velocity, Pitot pressure, and combined temperature measurement methods were evaluated for their accuracy in determining Mach numbers during rocket flights. Quantitative comparisons of the observed Mach values established the sound velocity measuring system as superior for Mach numbers between 0.5 and 4.0 with an error of 0.5 to 1.5%. The combined temperature method showed an error of more than 2% at Mach=3.5; and the Pitot pressure method gave more than 1% erroneous results for the studied Mach number range. Transl. by G.G.

N66-31979# Consolidated Electrodynamics Corp., Pasadena, Calif. Data Instruments Div.
SOME PRACTICAL ASPECTS OF AEROSPACE TAPE RECORDERS
J. J. Smith 27 Jan. 1966 15 p

Some considerations of the use of tape recorders in aerospace vehicles are discussed. The characteristics of magnetic tape, considered one of the most efficient media for temporary storage of information, are discussed, and tape with a width of 1 in. is recommended for use in aerospace vehicles since it presents the best mechanical characteristics for guidance past recording and reproducing heads. It is pointed out that cost is increased by requiring extremely low weight and low power consumption. The advantages and disadvantages of designed-to-order tape recorders and modification of existing units are discussed. Several parameters of recorder performance that present particular difficulties when operating in a space vehicle environment are outlined, including flutter, and dynamic skew, or interchannel time displacement error. New developments are projected, i.e., use of integrated circuitry, increase in lateral and longitudinal information density, and improvement in magnetic tape. Suggestions to achieve to the optimum use of magnetic tape are also given. L.E.W.

N66-31980# National Aero- and Astronautical Research Inst., Amsterdam (Netherlands).
SPECIAL PURPOSE CODES FOR SERIAL RECORDING ON STAINLESS STEEL WIRE
A. J. L. Willekens [1966] 25 p refs Presented at the 4th Intern. Aerospace Instrumentation Symp., Cranfield, England, 1966
(MP-238) CFSTI: HC $1.00/MF $0.50

In the digital recording system designed by the NLR for the Fokker F-28 prototypes a tape recorder is used for storing the information. This tape recorder functions only during the actual flight measurements. In addition to this, a wire recorder is used for crash recording. This recorder, which obtains its information from the same data acquisition system, is running during the whole flight. The packing density

used on the wire is about twice the value for which the recorder is normally used. This could be realized by the use of a serial code, specifically designed to minimize the influence of jitter and to simplify the ground equipment. The input to the wire recorder is 50 words per second. Each word contains 3 decimals and a polarity indication; a total of 20 bits is required. The code is described and it is shown how character, word and frame synchronization are achieved. The possibility of false synchronizations is discussed. The layout of the airborne and ground parts is shortly described. For deserializing use is made of a digital computer. Author

N66-32005# Centre d'Essais en Vol, Bretigny-sur-Orge (France).

ACCURATE MEASUREMENT OF AIRCRAFT ATTITUDE USING AIRBORNE CAMERAS AND THEODOLITES

A. Boisson [1966] 19 p Presented at the 4th Intern. Aerospace Instrumentation Symp., Cranfield, England, Mar. 1966 CFSTI: HC $1.00/MF $0.50

A method is described for measuring the three angles that define the directions of longitudinal, lateral, and directional axes of aircraft attitude. The orientation of the camera axes with respect to aircraft axes is considered to show the necessity of measuring the coordinates of the aircraft with respect to the ground, while measuring the aircraft attitude at the same time. The aircraft is tracked by cinetheodolites, two of which are required to determine the position of the aircraft. A reference point for the aircraft is provided by searchlights mounted along the path. Possible causes of inaccuracies are listed as film deformation, optical aberration, errors in reading the searchlight coordinates, and alignment. Experimental verification of the method is discussed, and the limits of use correspond to an altitude of 500 meters. High accuracy, compact airborne equipment, use of standard flight test equipment, rapid read out, and short computation time are cited as advantages of this method. S.P.

N66-32052*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

ADVANCED EARTH SENSOR DESIGN CONSIDERATIONS

Barbara K. Lunde *In its* Publ. of Goddard Space Flight Center, 1963, Vol. II [1963] p 299-301 ref (See N66-32044 18-31) CFSTI: HC $7.00/MF $5.00

Reliability must be improved by an order of magnitude before earth sensors can be of practical use in operational systems. This requires a new design which is thermal, rather than optical, and detectors which are extremely stable, rather than sensitive and fast. These elementary requirements have not been recognized by the industry. Author

N66-32053*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

RELIABILITY VERSUS ACCURACY TRADEOFFS

Barbara K. Lunde *In its* Publ. of Goddard Space Flight Center, 1963, Vol. II [1963] p 302-306 (See N66-32044 18-31) CFSTI: HC $7.00/MF $5.00

Spacecraft earth sensors, used in stabilization and control systems for downward orientation, were evaluated for their accuracy and reliability. Mean time to failure analyses for Mercury and OGO satellite horizon scanners established the mechanical modulator in infrared sensors and inhomogeneities in the earth temperature as main error sources. Substitution of the mechanical chopper with two identical detectors that compare their outputs regularly and employ electronic compensation to reduce the cross coupling error, evolved as an improved design concept. Reliability and accuracy estimates for this modified sensor system are presented and compared to accuracy estimates for other new sensor designs. G.G.

N66-32054*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

A RELIABLE EARTH SENSOR FOR ATTITUDE SENSING

Barbara K. Lunde *In its* Publ. of Goddard Space Flight Center, 1963, Vol. II [1963] p 307-312 (See N66-32044 18-31) CFSTI: HC $7.00/MF $5.00

Proposed specifications for an improved reliable earth sensor to be used in spacecraft attitude control include an infrared lens with aspheric surface for imaging earth pictures onto a detector array, and filters to select the wavelengths which will reach the heat detector array which will in turn measure the amount of infrared energy by eight infrared-sensitive elements arranged in opposite pairs. The output of opposite detectors is compared and amplified by the electronics contained in the sensor; the time constants of the detectors will determine the temperature difference versus offset coefficient. G.G.

N66-32056*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

DATA STORAGE FOR METEOROLOGICAL SATELLITES

M. I. Schneebaum and R. A. Stampfl *In its* Publ. of Goddard Space Flight Center, 1963, Vol. II [1963] p 357-362 (See N66-32044 18-31) CFSTI: HC $7.00/MF $5.00

Electronic and magnetic data storage of video information in meteorological satellites requires a storage vidicon to convert optical image patterns into electrical charge patterns, and a dielectric tape camera to store the electric charge patterns on thin coated films for later readout by electric beam scanning. A dielectric tape camera configuration is described that combines observational and storage functions and is able to store two complete orbits with horizon-to-horizon coverage at 0.2 mi. ground resolution. Also reported is the construction of a tape recorder with an endless loop cartridge that will record analog videos with frequently modulated subcarriers. G.G.

N66-32060*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

FINE SUN TRACKER FOR ADVANCED ORBITING SOLAR OBSERVATORY

Clarence Cantor *In its* Publ. of Goddard Space Flight Center, 1963, Vol. II [1963] p 497-505 ref (See N66-32044 18-31) CFSTI: HC $7.00/MF $5.00

The analysis and design of a fine sun tracker for the Advanced Orbiting Solar Observatory are discussed. The tracker provides accurate pointing information in pitch and yaw, permitting precise static and dynamic orientation of the observatory with respect to the sun's apparent disc, in accordance with ground commands. The tracker uses a servo driven optical slab in each axis to offset the optical null by the required amount. The error signal thus developed in a pair of matched silicon photo-voltaic cells is fed to the observatory control system, to produce the desired orientation in that axis. The essential features of the tracker design are incorporated in a breadboard model. The performance of this model verifies the inherent capability of the design to achieve a 2 arc-second r.m.s. pointing accuracy. Author

N66-32062*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

FAILURE PROBLEM WITH A RHENIUM MASS SPECTROMETER FILAMENT AND ITS SOLUTION

A. G. Eubanks and H. E. Frankel *In its* Publ. of Goddard Space Flight Center, 1963, Vol. II [1963] p 542–545 ref (See N66-32044 18-31) CFSTI: HC $7.00/MF $5.00

Rhenium mass-spectrometer filaments to be used in an atmospheric structure satellite failed when prototype spectrometer models were subjected to shock and vibration testing. Laboratory analysis showed that the failures were due to cold-working of a filament wire in a critical area. A redesign of the filament was carried out to alleviate this problem and subsequent testing showed that the new design was successful in that no additional failures occurred. Author

N66-32064*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

ATMOSPHERIC SAMPLING INSTRUMENTATION

Nelson W. Spencer *In its* Publ. of Goddard Space Flight Center, 1963, Vol. II [1963] p 583–586 (See N66-32044 18-31) CFSTI: HC $7.00/MF $5.00

The use of a capsule as instrument carrier for Martian atmospheric measurements is advocated as a reliable and safe exploration device. The capsule will enter the planetary atmosphere by parachute and deploy its antennas and sensors during descent to the surface. Its sensors will obtain the following measurements: (1) atmospheric temperature and pressure data from thermistors and potentiometer gauges; (2) mean molecular mass and air density from acoustic devices; and (3) the total amounts of CO_2, H_2O, and O_3 for the area between the sensor and the sun by infrared absorption detector. The obtained information can then be utilized to determine the temperature, pressure, density, and gross composition profiles of the Martian atmosphere. G.G.

N66-32065*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

A MASS SPECTROMETER FOR AN AERONOMY SATELLITE

Nelson W. Spencer and C. A. Reber *In its* Publ. of Goddard Space Flight Center, 1963, Vol. II [1963] p 587–589 refs (See N66-32044 18-31) CFSTI: HC $7.00/MF $5.00

A double-focusing mass spectrometer designed for the quantitative measurement of atmospheric H_e, N, O, H_2O, N_2, and O_2 is described. The instrument will detect particle densities of approximately 10^5 per cc, and has weight and power requirements appropriate to satellite use. Author

N66-32087# Illinois Univ., Urbana.

A VERSATILE HIGH PRESSURE MOSSBAUER APPARATUS

P. Debrunner, R. W. Vaughan, A. R. Champion, J. Cohen, J. Moyzis et al [1965] 31 p refs

(Contract AT(11)-1198; Nonr-1834(05))

(COO-1198-365; AD-632577) CFSTI: HC $2.00/MF $0.50

An apparatus was developed which permits high pressure Mossbauer resonance studies to 300 kilobars. It can be operated with either the source or the absorber under pressure. The pressures are established by X-ray diffraction measurements, and calibration curves are presented for both the supported taper and Bridgman anvils cells. A motion device involving magnets and phosphor bronze springs, with an adjustable mount is described. Circuits necessary to control the motion, and to distribute the signals from two devices operating in parallel are outlined. Author (TAB)

N66-32138*# Honeywell, Inc., Boston, Mass. Radiation Center.

OCULOMETER Interim Technical Report, 25 Feb.–25 Dec. 1965

John Merchant 31 Jan. 1966 108 p *Its* Doc.-66-4

(Contract NASw-1159)

(NASA-CR-76637) CFSTI: HC $3.00/MF $0.75 CSCL 14B

Described are the system design and performance characteristics of a telescopic oculometer, containing an eyepiece of a conventional monocular telescope, used to measure the angular direction of human eye movement. The angular direction of the eye was determined independently of small lateral motions of the head by measuring the position of a corneal reflection relative to the center of the eye pupil, and appropriate corrective action was defined for the problem of satisfactorily tracking the corneal reflection within the eye. Photographs, schematics, and function diagrams portray the breadboard assembly prepared for the optical, mechanical, and electronic equipment and instrumentation. Two-dimensional tracking of the pupil–iris boundary, essential to the proposed eye measuring technique, was accomplished. The basic relationship between eye direction (independent of position) and the location of a corneal reflection within the pupil is established by direct observation, and the results obtained are considered sufficient to establish the feasibility of tracking the pupil–iris boundary of the human eye, as it looks through a conventional eyepiece. R.U.

N66-32152# Army Engineer Geodesy, Intelligence and Mapping Research and Development Agency, Fort Belvoir, Va.

PRODUCT IMPROVEMENT TEST REPORT OF ASTRONOMIC SURVEYING EQUIPMENT Final Report, Mar. 1962–Feb. 1965

Peter J. Cervarich Mar. 1966 169 p refs

(Rept.-28-TR; AD-632776) CFSTI: HC $5.00/MF $1.00

This report covers the Product Improvement Tests of the following items: (1) 60° Pendulum Astrolabe with Electronic-Transit Detector; (2) Strip Chart Data Recorder; (3) Electronic Chronometer; (4) Radio Time-Standard Receiver; and (5) Computer Programs for Astronomic Problems. Also included is a preliminary test report on the Kern DKM-3A Theodolite. The objective of this task was to re-examine the current astronomic position determination sets and to modernize and update these sets. This report concludes with a suggested equipment set for the field determination of astronomic latitude, astronomic longitude, and astronomic azimuth. Author (TAB)

N66-32171# General Electric Co., Schenectady, N. Y.

FEASIBILITY STUDY OF PROPELLER VIBRATION RECORDING SYSTEM Final Engineering Report

J. B. Gibbons Mar. 1966 128 p refs

(Contract FA-64-WA-5046)

(ADS-45)

Feasibility studies were made of recording propeller strains at 64 positions for 200 hours of flight. The frequency response of the data extended from d.c. to 1000 cps. A system has been devised to record the signal characteristics of interest using an intermittently operated magnetic tape recorder to record high level signals at full frequency response and a slow speed recorder to maintain a continuous log of the peak signal history. A key feature of the system is the elimination of slip rings to transmit signals from, and power to, the propellers. Many of the system components are now in production. A few require development. The principal limitation of the system is the difficulty of measuring static strains over a wide

temperature range. A method of compensation is proposed which corrects temperature errors over a restricted temperature range. Author

N66-32172# Ether Langham Thompson, Ltd., Bushey (England).

THE DESIGN OF TRANSDUCERS INCORPORATING SEMICONDUCTOR STRAIN GAUGES

F. E. Duffield [1963] 29 p refs

With present techniques solid-state strain elements having high piezoresistive sensitivities may be produced in a number of forms suitable for transducer applications. Some transducer designs incorporating these elements are described in this paper. These instruments have high signal levels and possess many desirable features for flight instrumentation systems. Author

N66-32192# Atomic Energy of Canada, Ltd., Chalk River (Ontario).

PRELIMINARY TESTS ON ENCAPSULATED LITHIUM-DRIFT GERMANIUM GAMMA-RAY SPECTROMETERS MADE BY RCA VICTOR RESEARCH LABORATORIES, MONTREAL

I. L. Fowler and R. J. Toone May 1966 19 p refs

(AECL-2569; GPI-59) CFSTI: HC $1.00/MF $0.50

Tests have been carried out on three encapsulated germanium lithium-drift γ-ray spectrometers. The detectors are approximately 2 cm^2 in area and 2 mm depletion (sensitive) depth and are encapsulated in modified standard steel transistor cans. After a straight-forward electrical clean-up procedure the detectors were cooled to liquid nitrogen temperature (77°K) and gamma spectra taken. All three detectors gave resolutions of 2.6 to 2.7 keV (fwhm) for 122 keV γ-rays, and 6.3 keV for 1173 keV γ-rays. The detectors were found to operate satisfactorily after storage for several days in a freezer at −22°C without further clean-up. One detector was operated, cooled to near 77°K with liquid nitrogen, in an insulated mount with no vacuum system. Such an arrangement is only possible with encapsulated detectors of this type and should prove convenient for many users for short-term experiments. Details of this non-vacuum mount are given. Author

N66-32234*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

GROUND WIND MEASUREMENTS AND ANEMOMETER RESPONSE

James R. Scoggins *In* NASA. Langley Res. Center Meeting on Ground Wind Load Probl. in Relation to Launch Vehicles [1966] 26 p refs (See N66-32226 18-32) CFSTI: HC $5.29/MF $2.25

The theoretical response of inertia-type anemometers is presented. The determination of response parameters using theory and wind tunnel data is explained and examples given. A comparison of simultaneous anemometer measurements in a real wind environment is made from which inferences are drawn regarding the validity of response parameters determined in a wind tunnel. Finally, the ground (Sfc. to 150 m) wind measurement program is discussed, and some practical problems in measuring ground winds outlined. Author

N66-32235*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

WIND MEASUREMENTS USING A VERTICAL ARRAY OF FAST RESPONSE ANEMOMETERS

Rodney L. Duncan and Jerome T. Foughner, Jr. *In its* Meeting on Ground Wind Load Probl. in Relation to Launch Vehicles [1966] 18 p refs (See N66-32226 18-32) CFSTI: HC $5.29/MF $2.25

Orthogonal horizontal wind components are measured using a vertical array of 5 fast response anemometers mounted at vertical separation distances of 50 feet on the 250-foot meteorological tower. The transducer, a drag sphere type anemometer, and the test area are briefly described. Initial data in the form of power spectra up to 5 cps and the coherency between similar components at two measuring stations are presented for the 200 and 250 foot level. The spatial correlation of gusts is discussed in terms of gust loads on launch vehicles. Plans for wind measurements using an additional array of fast response anemometers up to 53 feet and a program to experimentally test the validity of Taylor's hypothesis are described. Author

N66-32281*# Southwest Research Inst., San Antonio, Tex.

VIBRATING DIAPHRAGM PRESSURE TRANSDUCER

J. Derwin King Washington, NASA, [1964] 28 p refs Prepared for NASA

(NASA-SP-5020) CFSTI: HC $0.30/MF $0.50 CSCL 14B

The vibrating diaphragm pressure transducer has been successfully used to monitor pressures encountered in high velocity wind tunnels from atmospheric down to about 10^{-4} mm Hg. The device has a combination of characteristics that cannot be fully matched by any other type of transducer now used in the range of 10^{-5} to 10^{3} mm Hg. It covers a wider range than most types, is sensitive to absolute pressure, has small size and internal volume, has fast response, and provides a continuous indication of pressure. With little or no modification, it can be used as a differential capacitor pressure transducer, an electrometer input device of very high sensitivity, a magnetic damping measuring device, and an accurate multiplier for use with electronic analog computers. Although useful, obtaining desired characteristics and uniformity in the transducer still remains a fabrication problem. Further development of its electronic circuitry is needed for greater stability, accuracy, and range. R.N.A.

N66-32285*# Case Inst. of Tech., Cleveland, Ohio. Polymer Science Group.

CONSTRUCTION OF TORSIONAL PENDULUM FOR CRYOGENIC TEMPERATURES, PART IV Status Report, Oct. 31, 1965–Apr. 30, 1966

Eric Baer and I. Kuriyama [1966] 14 p refs

(Grant NGR-36-003-054)

(NASA-CR-76739) CFSTI: HC $1.00/MF $0.50 CSCL 20M

The design and construction of a torsion pendulum to study cryogenic properties of polymers down to liquid helium temperatures is described, and schematic diagrams are given. The apparatus is enclosed in a vacuum system for low temperatures ranging from 4.2° to 300°K, and consists of a pendulum, an optical recording system for the oscillatory motion, and a cryostat chamber. Experimental procedure and sample preparation are discussed, and the data confirmed that the pendulum was capable of measurements of relaxations in polymers down to 4°K. L.E.W.

N66-32311# General Electric Co., Schenectady, N. Y. Research and Development Center.

TIME-OF-FLIGHT SPECTROMETER Quarterly Report

G. C. Baldwin Nov. 1965 5 p

(Contract NOnr-3942(00))

(GR-12; AD-624825) CFSTI: HC $1.00/MF $0.50

Activity was concentrated on completion of the computer program for data reduction and on the installation and checkout of the auxiliary system for sample gas supply and pressure measurement. An investigation of the statistics of the detector was begun. Numerous calibration runs were made to refine bias settings. TAB

N66-32321# Centre National de la Recherche Scientifique, Verrieres-le-Buisson (France). Service d'Aeronomie.

THERMISTOR ALTIMETER FOR HIGH ALTITUDE BALLOON FLIGHTS

T. F. Heinsheimer [1966] 37 p refs Presented at 4th Intern. Aerospace Instrumentation Symp., Cranfield, England, 21–24 Mar. 1966

CFSTI: HC $2.00/MF $0.50

The design, fabrication, test, and operation of a thermistor altimeter for high altitude balloon flights are presented. The instrument is based upon the change in heat transfer from a small bead thermistor to the surrounding air as a function of ambient pressure. The problems of measuring this phenomenon are analyzed and flight test results are reported. It is concluded that the instrument is compatible with balloon requirements and correctly optimized for maximum accuracy over the range of pressures associated with such missions. The results also show that the altimeter could easily be modified for rocket applications. Diagrams of the altimeter are included along with several performance graphs. A.O.

N66-32354# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.

ELEVATED TEMPERATURE EXTENSOMETER FOR THE REMOTE TENSILE TESTING OF IRRADIATED SPECIMENS

R. W. Barker and P. K. Mc Daniel Oct. 1965 20 p

(Contract AT(45-1)-1830)

(BNWL-148) CFSTI: HC $1.00/MF $0.50

A standard commercial extensometer was modified to provide direct strain measurements in various elevated-temperature environments with the accuracy of ASTM class B-1 standards and the simplicity of the parent model. The modified extensometer was successfully employed with a remotized Instron machine in conducting several hundred tests of irradiated metals, alloys, and composite structures at temperatures to 500°C. Author (NSA)

N66-32357# Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.

TRANSDUCER DEVICE EVALUATION USING HIGH EXPLOSIVES

R. H. Meservey Apr. 1966 54 p refs

(Contract AT(10-1)-205)

(IDO-17148) CFSTI: HC $3.00/MF $0.50

A description is presented of the performance of various transducer devices as they were subjected to the transient forces produced by chemical explosives. Devices were tested for use in measuring dynamic overpressures and shock wave propagation velocities. Reactor disassembly detecting instrumentation in the form of accelerometers, linear displacement transducers, strain gages, event recording devices, optical trackers, and thermocouples were also tested. Dispersed fuel temperature measuring techniques were investigated by means of thermocouples and an optical pyrometer. The series of tests was conducted on behalf of the STEP program to determine appropriate instrumentation and instrumentation techniques for the SNAPTRAN-2 destructive test. Author (NSA)

N66-32370# Atomic Energy of Canada, Ltd., Chalk River (Ontario).

IMPROVEMENTS IN LARGE VOLUME COAXIAL GERMANIUM SPECTROMETERS

H. L. Malm Mar. 1966 31 p refs Presented at the IFFE 10th Scintillation and Semiconductor Counter Symp., Washington, D. C., 2–4 Mar. 1966

(AECL-2550; CRGP-1236) CFSTI: HC $2.00/MF $0.50

Large volume germanium lithium drift diodes coaxially drifted with one open end showed excellent performance as γ-ray spectrometers. However, limitations were found in the coincidence resolving times possible due to the large variations in charge collection times which result from the nonuniformity of the electric field, especially in the closed end portion. Leading edge time distribution studies were made using first a 6.6 cm long single open-ended diode with a trapezoidal cross section, then the two sections resulting from cutting off the closed end portion of this diode, and finally a diode made with two open ends from a crystal with a circular cross section. A considerable improvement in the width of the leading edge time distribution was observed with the last diode. The γ-ray resolution for ^{60}Co using a 15 cm^3 coaxial diode has been improved to 3.4 keV by using a low noise field effect transistor preamplifier. Author

N66-32391# Federal Aviation Agency, Atlantic City, N. J. National Aviation Facilities Experimental Center.

TRANSPORT AIRCRAFT VERTICAL ACCELERATION DETECTION

William A. Hiering and Charles R. Grisel Mar. 1966 41 p

(FAA-ADS-71)

Three commercially available accelerometer systems designed to measure vertical acceleration were evaluated for transport aircraft use by performing a series of laboratory and flight tests. The test results indicated that the off-the-shelf systems failed to record the flight test accelerations satisfactorily. However, the essential physical characteristics required of a transport aircraft's vertical acceleration sensing and recording system were determined from the flight test data. It was concluded that a transport's accelerometer system should contain three accelerometer units. Two identical accelerometer units mounted on the left and right landing gear mounting structure to sense landing impacts, and one accelerometer unit installed at the aircraft's c.g. position to sense flight accelerations. Airworthiness inspection requirements, due to aircraft vertical accelerations, may be ascertained by performing an engineering analysis of the recorded accelerations and the aircraft limit load data. Author

N66-32392# Ferranti, Ltd., Manchester (England).

PIEZORESISTIVE SILICON INTEGRATED CIRCUIT TECHNIQUES IN TRANSDUCER DESIGN

W. Thorp and T. Jones [1963] 11 p ref

This paper discusses the application of silicon integrated circuit techniques in fabricating strain gauge transducers. These techniques are shown to give considerable reduction in transducer size, high electrical output, good transducer characteristics, good reliability, and low cost devices. R.N.A.

N66-32396# Rosemount Engineering Co., Ltd., London (England).

SENSOR AND TRANSDUCER CONSIDERATIONS FOR S. S. T. FLIGHT AND FLIGHT-TEST INSTRUMENTATION

J. S. Johnston [1961] 15 p refs

This paper presents some of the problems encountered in the instrumentation of a supersonic transport and indicates some of the considerations involved in finding solutions. Temperature, vibration, icing, reliability, and electrical specifications for the SST are described. The application of these considerations to the design of various transducers and sensors is discussed. The instruments include pitot and pitot static tubes, total temperature sensors, ice detectors, and general temperature measuring devices. R.N.A.

N66-32397# Bendix Corp., Teterboro, N. J. Eclipse-Pioneer Div.

DESIGN CRITERIA OF THE BENDIX MULTIPURPOSE STAR AND PLANET TRACKER

G. V. Zito and S. Malkiel [1966] 37 p refs Presented at the 14th Intern. Aerospace Instrumentation Symp., Cranfield, England, 22 Mar. 1966

This paper discusses some of the design criteria of the multipurpose star and planet tracker. The tracker incorporates an image dissector as a detector and provides two-axis control signals in response to stars brighter than +3 visual magnitude as well as to the center of illumination of the planets Mars, Mercury, and Venus. The desired star tracker output characteristic is shown and consists of a limited zone of proportionality surrounded by a zone of signal saturation. A series of scanning spot excursions, at a 400 cps rate, transverse the .5 inch photocathode diameter while progressing clockwise at a 25 cps rate, producing an interlaced scan of 32 lobes. Multiplication is carried out by magneto-resistive bridge multipliers. Synchronous demodulation and filtering of the video signal results in the production of a 25 cps error signal. The tracker contains no moving parts and is intended for body-mounted applications. Author

N66-32398# Federal Aviation Agency, Atlantic City, N. J.

EVALUATION OF A THRUSTMETER FOR MEASURING IN-FLIGHT THRUST OF TURBOJET ENGINES

Robert F. Salmon Apr. 1966 63 p refs

(FAA-ADS-77)

An airborne type thrust measuring instrument was developed and subsequently tested on both a turbojet engine mounted on a thrust stand in a laboratory altitude cell, and a turbojet engine aboard a Boeing 720 aircraft. The thrustmeter system using measurements of internal engine pressures, ambient altitude pressure and total air temperature, computed engine gross thrust, net thrust and percent of maximum continuous rated thrust at the operating flight condition. Laboratory tests indicated that: (1) the gross thrust value computed theoretically from the measured pressures were within ±2.0% of the thrust stand measured gross thrust, (2) the thrustmeter gross thrust values were within ±3.0% of the thrust stand measured values, (3) the net thrust values computed theoretically from the measured pressures were within ±3.9% of the thrust stand measured net thrust, and (4) the thrustmeter net thrust values were within ±4.2% of the thrust stand measured net thrust. The gross thrust computer module malfunctioned for a series of tests at a simulated altitude condition of 40,000 feet and Mach 1.2. Flight test results indicated that the system functioned properly aboard the aircraft and was responsive to small changes in engine power setting. The thrustmeter gross thrust and net thrust values agreed with the computed gross and net thrust of the engine within ±2.2% and ±2.8% respectively. In measuring net thrust during the flight tests, some difficulty was encountered in obtaining consistent static pressure readings at the compressor inlet station thus causing errors in the computation of ram drag. Author

N66-32415# European Atomic Energy Community, Brussels (Belgium).

INVOLVED ERRORS ON LIQUID LEVEL DETERMINATION BY DIFFERENTIAL PRESSURE [LES ERREURS DANS LA DETERMINATION DU NIVEAU D'UN LIQUIDE PAR DIFFERENCE DE PRESSION]

W. Becker and F. Sorel May 1966 37 p In FRENCH; ENGLISH summary

(EUR-2958.f) CFSTI: HC $2.00/MF $0.50

After a short survey on the principles of liquid level determination by differential pressure, the involved errors are treated. The errors are divided into the ones caused by barometric pressure changes in the tubes, if the purge bubble principle is applied, and those by variation of the liquid density with temperature. For the latter, a method for determination of mean temperature along the measured line by a resistance wire spiral is given, in case of inhomogeneous temperature distribution in the liquid. Since, because of the nonlinear relation between density and temperature in liquids, the mean density cannot exactly be determined by the measured mean temperature, the appearing error is calculated in a general form by approximating the density temperature function with a Taylor's series. It appears, that the error estimation is, under certain conditions, independent on the temperature distribution. Examples for all kinds of errors and diagrams of normalized error are given. Finally, the tranformation problem of the output values of the measurement instrument into the display value is shortly treated. Author

N66-32420# National Bureau of Standards, Boulder, Colo.

ACCURACY IN ELECTRICAL AND RADIO MEASUREMENTS AND CALIBRATIONS, 1965

R. C. Powell, ed. 15 Jun. 1965 105 p refs Excerpt from NBS-TN-262

(NBS-TN-262-A; NBS-TN-262) GPO: $0.50

National Bureau of Standards estimates of uncertainties associated with electrical and radio physical measurements, and with some calibration services, are shown by 42 provisional "accuracy charts". Each chart is accompanied by a facing page giving a brief statement of the state-of-the-art, and tentative plans for work in areas where improvement is needed. Author

N66-32491# Marine Engineering Lab., Annapolis, Md.

DEVELOPMENT OF A THERMOELECTRIC GENERATOR-POWERED SOLID-STATE 100-WATT BEACON SYSTEM Research and Development Report

Donald B. Steen Apr. 1966 36 p refs

(MEL-83166; AD-632847) CFSTI: HC $2.00/MF $0.50

A solid-state 100-watt navigational beacon power system employing a propane-fired, 30-watt, thermoelectric power supply, a capacitor energy storage bank; and a 5-second, one-quarter duty cycle, solid-state flasher has been developed for possible replacement of present Coast Guard battery-powered systems using mechanical flashers. System development began with determining the electrical characteristics and performance of the thermoelectric power supply in severe ocean environments. The power supply was modified to increase its reliability and wind resistance. The system meets the environmental and reliability specifications required for buoy operation. The MEL thermoelectric generator-powered beacon system is technically and economically superior to battery-powered, mechanically flashed systems, and the many advantages of solid-state apparatus should be exploited for Coast Guard use. A cost comparison was made with an advanced power system using air depolarized batteries and a

sun switch to extend the buoy service period to the same 1-year service period required to refuel the thermoelectric generator. The comparison showed that the estimated 10-year procurement costs of $12,200 for the battery system could e reduced to only $1,600 by use of the MEL thermo-electric generator-powered system. Author (TAB)

N66-32509# Naval Radiological Defense Lab., San Francisco, Calif.

LOW DOSE MEASUREMENTS WITH MODIFIED SILVER-PHOSPHATE GLASS DOSIMETER READER

Cirel K. Menkes 30 Aug. 1965 45 p refs

(USNRDL-TR-889; AD-622636) CFSTI: HC $2.00/MF $0.50

Greater precision in measuring gamma-ray doses below 1.0 R with silver-activated phosphate glass was achieved by modification of the Toshiba FGD-3B Fluoro Glass Dosimeter Reader. Twenty-five milliroentgen (25 mR) was read on 6 mm×6 mm×3.3 mm glass square dosimeters with an accuracy of about 5%, suggesting that results of this precision should be obtainable with more sensitive glass dosimeters down to 10 mR or less. Fluorimetric emission spectra and measurements made after replacement of the red filter by a yellow filter in the Toshiba reader indicate that the predose of Toshiba silver phosphate glass has a relatively significant fluorescence in the region of the irradiation-induced fluorescence.

Author (TAB)

N66-32525# Coast and Geodetic Survey, Rockville, Md.

COMPARISON TESTS OF ELECTRO-OPTICAL AND MICROWAVE DISTANCE MEASURING INSTRUMENTS

Buford K. Meade [1965] 18 p Presented at 10th Pan Consultation on Cartography, Guatemala, 25 Jun.–10 Jul. 1965

(PB-169333) CFSTI: HC $2.60/MF $0.50

Test procedures to compare electro-optical (geodimeter models) and microwave (electrotape and tellurometer devices) distance measuring instruments are described in detail. Various calibration techniques and methods of checking instrumental constants are discussed. The requirements for length measurements are defined, and results of the measurements tabulated. Measurements made indicated that consistent results accurate to one or two centimeters can be obtained with the geodimeters. Measurements made with the electrotape and tellurometer instruments were in good agreement with the geodimeter when the final result was a mean of several measurements taken on different days. L.E.W.

14

N66-32527# Central Lab. for Radiological Protection, Warsaw (Poland).

STRONTIUM-90–YTTRIUM-90 MEASUREMENTS USING SILICON COUNTERS

A. Dabrowski, M. Jagusztyn, and J. Roman 1966 24 p refs

(CLOR-45/D) CFSTI: HC $1.00/MF $0.50

Large-area silicon surface-barrier detector with a guard-ring has been constructed and used for low-level Sr^{90}–Y^{90} beta assay. The counting efficiency was of about 41 per cent and the background count was less than 1.5 cpm. The counter has proved to be well suited for routine use under ordinary laboratory conditions. Author

N66-32557# Institut Franco-Allemand de Recherches, St. Louis (France).

STATIC AND DYNAMIC CALIBRATION OF QUARTZ PRESSURE GAGES [STATISCHE UND DYNAMISCHE EICHUNGEN VON QUARZ-DRUCKGEBERN]

M. Froboese 31 May 1965 56 p refs In GERMAN

(ISL-2/65)

The reliability of statically calibrated piezoelectric pressure gauges in dynamic measurements of air shock waves is investigated. Static and dynamic calibration experiments with low pressure shocks were conducted on quartz gauges. A shock tube and a high pressure pistonphone were used for the dynamic calibration. It was found that the results from the dynamic tests were sufficiently close to the static calibration values, thus making the much simpler static calibration method acceptable. Transl. by K.W.

N66-32573# National Bureau of Standards, Washington, D. C.

GUIDE TO INSTRUMENTATION LITERATURE

Julian F. Smith and W. G. Brombacher 7 Jul. 1965 245 p refs Supersedes NBS-Circ.-567

(NBS-Misc.-Publ.-271; NBS-Circ.-567) GPO: $1.25

A source list of instrumentation literature, with a subject index, and an index of personal and corporate authors was compiled. It includes related topics, i.e., electronics, computers, and metrology, selected from books, manuals, reference works, and data compilations; publications offering abstracts or indexes; periodicals; bibliographies; buyers' guides; and guides to dissertations, patents, and standards. H.S.W.

N66-32590# Library of Congress, Washington, D. C. Aerospace Technology Div.

AEROSPACE INSTRUMENTATION Surveys of Foreign Scientific and Technical Literature

Jordan V. Randjelovic, comp. 18 May 1966 68 p refs Compilation of abstracts

(ATD-66-58)

This compilation of abstracts is based on Soviet open sources published 1965–1966. Information not directly related to the assigned subject has been included because of its broad implications for study in this field. The 34 abstracts are arranged alphabetically by author within each of the following categories: (1) Magnetometer studies (4 entries); (2) Cosmic and corpuscular radiation detection (23 entries); (3) Electromagnetic radiation (6 entries); (4) Pressure sensors (1 entry). Other information included: world magnetic survey program experiments, ferroprobe gradiometer, Earth's magnetic field measurement, upper atmosphere soft electron fluxes, cosmic radio emission intensity, particle studies, outer ionosphere composition, satellite radiometric instrumentation, Cosmos and Electron satellite investigations, geometric distribution and composition of particles in the Earth's radiation belts, charged particle recording and investigation. The bibliography at the end of the report comprises 34 entries. Author

N66-32642*# Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.

DOUGLAS TASKS FOR AIRBORNE SOLAR ECLIPSE EXPEDITION OF MAY 30, 1965

R. M. Cameron Aug. 1965 173 p refs

(Contract NAS2-2703)

(NASA-CR-76980; SM-48792) CFSTI: HC $3.25/MF $1.00 CSCL 01C

The following four tasks are described: (1) procuring, mounting, and environmental testing of optical viewing windows prior to installation in the NASA CV-990 aircraft; (2) certification of tie-down of scientific equipment to Federal Aviation Agency emergency load specifications and installation aboard expedition aircraft; (3) analysis of navigational problems and preparation of a plan for mid-Pacific interception of the solar eclipse path; and (4) fabrication of a

gyroscopically controlled heliostat system and operation of this instrument during the solar eclipse flight. Equipment illustrations, flight plans, schematics, and detailed diagrams are included. K.W.

15 MACHINE ELEMENTS AND PROCESSES

Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control, and reliability; drafting; and materials fabrication, handling, and inspection.

N66-31420*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

PROCEEDINGS OF THE CONFERENCE ON THE DESIGN OF LEAK-TIGHT FLUID CONNECTORS

[1965] 214 p refs Conf. held 4-5 Aug. 1965 Sponsored jointly by NASA and SAE

(NASA-TM-X-57585) CFSTI: HC $6.00/MF $1.25 CSCL 13E

Technical papers concerning design, testing, and instrumentation of separable, semipermanent and permanent leak-tight fluid connectors for space vehicle use are presented. For individual titles see N66-31421-N66-31442.

N66-31421*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

ASPECTS OF ZERO LEAKAGE TECHNOLOGY

P. G. Hass *In its* Proc. of the Conf. on the Design of Leak-Tight Fluid Connectors [1965] p 1-2 (See N66-31420 18-15) CFSTI: HC $6.00/MF $1.25

The present technology concerning fluid connectors for launch and spacevehicles is reviewed, and the future design criteria are described. It is pointed out that for future space vehicles, the allowable leakage will be reduced to a value like 10^{-6} cc/s. A separable connector concept using semi-permanent joints designed not to be taken apart and reassembled more than 3 or 4 times is discussed. Environmental requirements are indicated as operating pressures to 6000 psi, extension of temperature range to 1500°F, and duct diameters up to 18 inches. N.E.N.

N66-31422*# Douglas Aircraft Co., Inc., Huntington Beach, Calif. Space Systems Center.

DEVELOPMENT OF SEPARABLE CONNECTORS FOR THE SATURN S-IV STAGE

E. C. Wilson, R. J. Coronado, and O. D. Pierson *In* NASA. Marshall Space Flight Center Proc. of the Conf. on the Design of Leak-Tight Fluid Connectors [1965] p 3-8 (See N66-31420 18-15) CFSTI: HC $6.00/MF $1.25

The manufacturing, selection and evaluation, and check-outs of seals and connectors are reviewed. The sources of connector leakage are identified. The types of connectors in the subsystems and the subsystem operating environments are outlined. The methods and procedures used in leak checks are described. It is pointed out that as the S-IV program proceeded, the propulsion system grew in complexity, but also that improvements in installation and over-all decrease leakage occurred. It was felt that effectiveness of the connectors was demonstrated. N.E.N.

N66-31423*# Rocketdyne, Canoga Park, Calif.

THE PRACTICAL ASPECTS OF STATIC-JOINT LEAKAGE MONITORING

D. E. Stuck and G. L. Dusenberry *In* NASA. Marshall Space Flight Center Proc. of the Conf. on the Design of Leak-Tight Fluid Connectors [1965] p 9-15 (See N66-31420 18-15) CFSTI: HC $6.00/MF $1.25

Leakage monitoring of hardware from initial component through separable connector assembly and during engine firing is described. The methods of static leak detection discussed are soap solution, pressure lockup, liquid submersion, rotameter, and mass spectrometry. The majority of hot-fire leakage data was obtained with a mass flowmeter, but balloon, sight glass, water displacement, and burst diaphragm methods were also employed. The operation and evaluation of the flowmeter are described in detail. Among the conclusions are: The flowmeter is a feasible method for in-flight and hot-fire monitoring. The ability to seal hydrocarbon fuels consistently during engine operation was demonstrated. Monitoring during all stages of development is necessary. N.E.N.

N66-31424*# General Electric Co., Schenectady, N. Y. Advanced Technology Labs.

A SEPARABLE CONNECTOR DESIGN HANDBOOK

F. O. Rathbun, Jr. *In* NASA. Marshall Space Flight Center Proc. of the Conf. on the Design of Leak-Tight Fluid Connectors [1965] p 17-24 refs (See N66-31420 18-15) CFSTI: HC $6.00/MF $1.25

The handbook for flanged and threaded connector design, seals, leakage measurement techniques, and material properties and comparibility is reviewed. The problems of leakage existing across the interface in the sealing area and that of the design of the supporting structure which holds the interfaces together are covered. The fundamental considerations of design and design evaluation are described. Schematics of typical designs, and typical requirements are included. A discussion on compromises which must be made by the designer is also presented. N.E.N.

N66-31425*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

APPLICATION OF LOW PROFILE FLANGE DESIGN FOR SPACE VEHICLES

W. P. Prasthofer *In its* Proc. of the Conf. on the Design of Leak-Tight Fluid Connectors [1965] p 25-39 refs (See N66-31420 18-15) CFSTI: HC $6.00/MF $1.25

There is evidence that the low profile flange configuration may be used advantageously in bolted flange connections. Test data substantiate the concepts of the low profile design. The application of this flange for short tubes, manhole, and manhole covers will increase the reliability, and reduce weight and space for the installation. The low profile flange equalled or exceeded the performance of the Taylor forge-type flange. The tested specimens were up to 37 percent lighter and also less bulky. Author

N66-31426*# General Electric Co., Schenectady, N. Y. Advanced Technology Labs.

MATHEMATICAL APPROACH TO INTERFACE PHENOMENON

L. G. Gitzendanner *In* NASA. Marshall Space Flight Center Proc. of the Conf. on the Design of Leak-Tight Fluid Connectors [1965] p 41-49 refs (See N66-31420 18-15) CFSTI: HC $6.00/MF $1.25

The need for increased understanding of the sealing phenomena in the design of reliable leak-tight fluid connectors is noted. Progress made in developing a mathematical model for estimating the probability of leakage exceeding a given level under stated conditions is reviewed; the steps yet to be developed before this estimate can be completed are also noted. Author

N66-31427*# Battelle Memorial Inst., Columbus, Ohio.
PERFORMANCE OF AFRPL STAINLESS STEEL CONNECTORS
B. Goobich and R. L. Humphrey *In* NASA. Marshall Space Flight Center Proc. of the Conf. on the Design of Leak-Tight Fluid Connectors [1965] p 51–57 refs (See N66-31420 18-15) CFSTI: HC $6.00/MF $1.25

This paper describes the connector capable of sealing 4000-psi helium at −320° and at +600°F. Maximum leakage of 4×10^{-7} atm cc/sec was recorded in the testing of 28 specimens representing 1/2- and 3/4-inch unions, tees, and elbows. These were subjected to thermal shock at −320° and +600°F, stress reversal bending, vibration at resonant frequencies, and repeated assembly. Average maximum leakage was 2.6×10^{-8} atm cc/sec. The tests are described and results are detailed and evaluated. Design features which make the high performance level possible are discussed. Author

N66-31428*# General Electric Co., Schenectady, N. Y. Advanced Technology Labs.
A HIGH-TEMPERATURE THREADED CONNECTOR DESIGN
J. Wallach and J. P. Laniewski *In* NASA. Marshall Space Flight Center Proc. of the Conf. on the Design of Leak-Tight Fluid Connectors [1965] p 59–65 refs (See N66-31420 18-15) CFSTI: HC $6.00/MF $1.25

A separable threaded tube connector for gases at temperatues to 1440°F and pressures to 4700 psi has been successfully designed and tested. Operating conditions for design consideration included vibration, shock, impulsive pressure, proof pressure and burst pressure. The connector consists of a triangular nickel 200 gasket and a René 41 flange, union, and nut. Recessed knife-edges on the union and flange cut into the gasket to effect a seal. The seal is isolated from load vibrations by an independent load path. A buttress thread is used on the nut. Author

N66-31429*# Weatherhead Co., Cleveland, Ohio.
MINIATURIZED TUBE FITTINGS
John Nicol *In* NASA. Marshall Space Flight Center Proc. of the Conf. on the Design of Leak-Tight Fluid Connectors [1965] 67–73 (See N66-31420 18-15) CFSTI: HC $6.00/MF $1.25

Stress analysis of tube fittings revealed that by taking advantage of the strength-to-weight ratio of titanium, weight reductions of 4 to 1 and volume reductions of 3 to 1 were possible. Titanium miniaturized flareless fittings were made and their performance capabilities were verified by tests to requirements with additional impulse-vibration at 600°F and thermal shock tests at −320°F. A flareless fitting sleeve with serrated cutting edge was found to have better gas sealing and retention characteristics than the standard sleeve. This is a review of some of the work that has been done to develop compact tube fittings for fluid systems in advanced flight vehicles to operate reliably through broader temperature ranges; particularly for hydraulic fluids at higher temperatures and for low molecular weight gases in cryogenic environments. These all-metal miniaturized fittings are for tube-to-tube connections such as straight connectors, elbows, tees and crosses; or for direct connection to component bosses. Author

N66-31430*# Los Alamos Scientific Lab., N. Mex.
THE IMPORTANCE OF QUALITY CONTROL AND INTEGRITY CHECKING
J. C. Bronson *In* NASA. Marshall Space Flight Center Proc. of the Conf. on the Design of Leak-Tight Fluid Connectors [1965] p 75–81 (See N66-31420 18-15) CFSTI: HC $6.00/MF $1.25

Methods used to obtain reliability in the use of separable connectors in a cryogenic environment are discussed. Bubble tight and vacuum vessel methods of leak checking are covered. Many illustrations of damaged and poorly machined fittings are included. Specific recommendations are given for enhancing the reliability of separable connectors. Author

N66-31431*# General Dynamics/Convair, San Diego, Calif.
PRECISION TUBE FLARING BY CONTROLLED METAL DISPLACEMENT
Joseph E. Carlin *In* NASA. Marshall Space Flight Center Proc. of the Conf. on the Design of Leak-Tight Fluid Connectors [1965] p 83–88 (See N66-31420 18-15) CFSTI: HC $6.00/MF $1.25

This paper presents a new concept in precision tube flaring for leak-proof separable connector joints. The device employs several new design concepts and mechanical applications compared with other types of tube flaring machines now used in the aerospace industry. It is a completely mechanical cycle machine, eliminating requirements for skilled operators. The power source is electro-hydraulic, controlling a unique clamping and ram-type flaring mechanism. The flare is formed in a closed, trapped-die arrangement using full mechanical control of material displacement, stroke, and pressure during the flaring cycle. The text of this paper will cover technical accomplishments and state-of-the-art improvements of flaring capability related to leak-proof, separable connector joints. Author

N66-31433*# Battelle Memorial Inst., Cleveland, Ohio.
AN EFFICIENT PROCEDURE FOR THREADED-CONNECTOR SELECTION
J. W. Adam *In* NASA. Marshall Space Flight Center Proc. of the Conf. on the Design of Leak-Tight Fluid Connectors [1965] p 99–106 refs (See N66-31420 18-15) CFSTI: HC $6.00/MF $1.25

The purpose of this paper is to suggest a more reasonable procedure for the selection of threaded connectors and to provide a basis for reducing the number and cost of qualification tests required. Included in the paper is a discussion of how the various connector characteristics such as deflection rates, seal seating loads, and torque–axial-load relationships can be determined and how they can be taken into account to predict leakage under various operating conditions. How these predictions can be used to establish the most critical areas for experimental investigation is also shown. Author

N66-31434*# General Electric Co., Schenectady, N. Y. Advanced Technology Labs.
CYCLIC STRAIN INDUCED CREEP—A SEPARABLE CONNECTOR DESIGN PROBLEM
R. L. George, F. O. Rathbun, Jr., and L. F. Coffin, Jr. *In* NASA. Marshall Space Flight Center Proc. of the Conf. on the Design of Leak-Tight Fluid Connectors [1965] p 107–116 refs (See N66-31420 18-15) CFSTI: HC $6.00/MF $1.25

Cyclic strain induced creep can occur in ductile metals (potential gasket materials) when exposed to cyclic stresses such as may result from thermal effects or vibration induced

forces in a connector. Sufficient stress relaxation may result, especially when compounded by acoustic vibrational effects to allow leakage. The resulting loss of sealing stress, particularly during the first several cycles of loading, justifies further consideration of this phenomenon in the design of separable connectors. Author

N66-31435*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
THE DEVELOPMENT OF A NEW CRYOGENIC GASKET FOR LIQUID OXYGEN SERVICE
James E. Curry and William G. Scheck (Whittaker Corp.) *In its* Proc. of the Conf. on the Design of Leak-Tight Fluid Connectors [1965] p 117–128 refs (See N66-31420 18-15) CFSTI: HC $6.00/MF $1.25

A research and development program was conducted to develop a plastic gasket material compatible with liquid oxygen that would be superior to the gaskets presently being used for Saturn space vehicle applications. A laminated gasket composite of Teflon and glass was developed. This gasket composite was tested at 75°, −320°, and −423° F. The conclusion was that 500 psi of helium gas pressure could be contained by this gasket. The major advantage of this gasket composite is that it is flexible and requires no retorquing of the bolts due to cold flow as exhibited by various other materials. Author

N66-31436*# Martin Co., Denver, Colo.
DESIGN AND DEVELOPMENT OF AN ELASTOMER SEAL FOR LONG TERM HAZARDOUS PROPELLANT STORAGE
J. P. Marcus, W. A. Day, and J. G. Jelinek (Parker Seal Co.) *In* NASA. Marshall Space Flight Center Proc. of the Conf. on the Design of Leak-Tight Fluid Connectors [1965] p 129–144 refs (See N66-31420 18-15) CFSTI: HC $6.00/MF $1.25

Containment of storable, chemically active missile propellants under long term storage conditions has normally been accomplished using stainless steel or special aluminum mechanical joints with all metal or plastic/metal gaskets. The containment of the oxidizer, nitrogen tetroxide using the above mentioned joint configurations has been problematical. An intensive effort has been carried out to develop and incorporate more effective mechanical joint configurations for the Titan II ICBM. This program has resulted in the qualification of a set of elastomer seals previously considered unsuitable for the application in N_2O_4. This paper presents the details of the design and development of these seals for long term containment of N_2O_4. Author

N66-31437*# General Electric Co., Schenectady, N. Y. Advanced Technology Labs.
SUPERFINISHED SURFACES AS A MEANS FOR SEALING
F. O. Rathbun, Jr. and R. S. White *In* NASA. Marshall Space Flight Center Proc. of the Conf. on the Design of Leak-Tight Fluid Connectors [1965] p 145–154 refs (See N66-31420 18-15) CFSTI: HC $6.00/MF $1.25

The feasibility of using superfinished surfaces on integral connector components in order to effect a separable seal which will not require a gasket, but will retain the characteristic of reusability, is discussed. The means for attaining such surface finishes, the degree of flatness required, the maximum asperity heights tolerated, and the stresses required to seal are described. The results of an experimental program in which several means of finishing, several different materials, and repetitive use of given surfaces were evaluated are outlined. The requirements for a connector in which such surfaces are used with regard to surface protection, surface cleanliness, and structural design are discussed. Author

N66-31438*# Douglas Aircraft Co., Inc., Santa Monica, Calif. Aerospace Systems Engineering.
AN EVALUATION OF A QUICK RELEASE FLUID COUPLING HAVING IDENTICAL MATING HALVES
W. T. Appleberry *In* NASA. Marshall Space Flight Center Proc. of the Conf. on the Design of Leak-Tight Fluid Connectors [1965] p 155–159 (See N66-31420 18-15) CFSTI: HC $6.00/MF $1.25

A new quick disconnect fluid coupling features identical halves that provide male/female mating. Advantages are reduction of inventory and renewal of defective seals without installing new ones. Two designs were evaluated: a hermaphroditic connector (coupling half converts from one sex to another), and a nonconvertible coupling using a face or butt type coupling-to-coupling seal. The hermaphroditic coupling was found superior. Advantages are (1) fewer seals used, reducing leakage, and (2) defective seals quickly replaced by simply converting both halves from one set to another. Author

N66-31439*# General Electric Co., Schenectady, N. Y. Advanced Technology Labs.
TWO FLUID CONNECTOR JOINING TECHNIQUES INVOLVING LARGE METAL DEFORMATION
J. P. Laniewski, F. O. Rathbun, Jr., and L. G. Gitzendanner *In* NASA. Marshall Space Flight Center Proc. of the Conf. on the Design of Leak-Tight Fluid Connectors [1965] p 161–176 refs (See N66-31420 18-15) CFSTI: HC $6.00/MF $1.25

Two separate techniques potentially useful in connector assembly, both involving large deformation of metals, are described. The first, that of cold welding or pressure welding, offers the possibility of establishing a hermetic seal which, if properly designed, is relatively insensitive to stress relaxation elsewhere in the structure. The incorporation of a cold welded seal into a prototype flanged connector suitable for 6,000 psi gas service for cryogenic temperatures is described. The second technique, high energy rate forming, offers distinct possibilities for structural component assembly and limited potential for establishing a seal. Both magnetic forming and explosive forming, often with welding resulting in the latter case, are discussed. Author

N66-31440*# General Electric Co., Schenectady, N. Y.
FLANGED OMEGA SEAL AND DIFFUSION BONDED CONNECTOR DESIGNS
L. G. Gitzendanner, F. O. Rathbun, Jr., and W. J. Harwick *In* NASA. Marshall Space Flight Center Proc. of the Conf. on the Design of Leak-Tight Fluid Connectors [1965] p 177–185 (See N66-31420 18-15) CFSTI: HC $6.00/MF $1.25

Two semi-permanent flanged fluid connector designs applicable for large diameter ducting systems, and designed specifically for insensitivity of sealing to reduction of bolt load, are described. The first, an omega seal connector, designed for 4700 psi service at 1440°F, incorporates a hermetic seal by the fusion welding of two segments of a thin toroidal shell about the periphery of the connector. The second design, that of utilizing a diffusion bond as the hermetic seal, allows the seal to be made in the field by the application of moderate heat and bolt stress. The diffusion bonded flanged connector was designed for 6,000 psi service at temperatures ranging between −450° and +100°F. Author

N66-31441*# Parker Aircraft Co., Los Angeles, Calif.
SWAGED TUBE AND DUCT CONNECTOR FEASIBILITY
K. R. Bragg *In* NASA. Marshall Space Flight Center Proc. of the Conf. on the Design of Leak-Tight Fluid Connectors [1965] p 187-198 *ref* (See N66-31420 18-15) CFSTI: HC $6.00/MF $1.25

Design and feasibility demonstration of a new concept for fluid line connectors. This semi-permanent connector depends solely upon cold forming of metal to carry structural loads and to make the helium leak-tight seal. The design objectives are stated. The connector is described; the preliminary test results are reported. The extent to which the objectives are met is reviewed, and finally, the follow-on effort required to make the connector available for production is visualized. Author

N66-31442*# Whittaker Corp., Chastworth, Calif. Controls and Guidance Div.
EXOTHERMIC BRAZING—A NEW CONVENIENCE FOR PERMANENT TUBE CONNECTIONS
Norman E. Weare *In* NASA. Marshall Space Flight Center Proc. of the Conf. on the Design of Leak-Tight Fluid Connectors [1965] p 199-203 *refs* (See N66-31420 18-15) CFSTI: HC $6.00/MF $1.25

The techniques of exothermic brazing and its advantages for permanent tube connections in aerospace applications are reviewed. The importance of an integrated design is emphasized, and an illustration of the components of such a unit is included. It is pointed out that exothermic brazing is distinguished from other brazing methods by: (1) being a precise form of heat; (2) having a extremely rapid heat pulse; and (3) being easy to use. The strength of brazed joints is discussed, and tables of burst, tensile, and flexure test data are presented. The low corrosion susceptibility and lack of internal contamination are mentioned. N.E.N.

N66-31574 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
MODEL OF FAILURE IN COMPONENTS
S. E. Benesch and C. R. Gates [1966] 15 p
(Contract DA-04-495-ORD-18)
(AD-631495)

The theory of failure is fundamental in understanding the reliability of complex systems. This paper is a review of some aspects of the theory of failure of particular interest to statisticians. There are two approaches available in this theory: the phenomenological and the microscopic; an example of the latter approach is the dislocation theory of fatigue wherein molecular and crystal mechanisms of this kind of failure are analyzed, while an example of the former approach is a statistical distribution curve which is fitted to failure probability vs time of light bulbs. Treated are models of failure leading to three frequency functions of failure: the normal, the logarithmic-normal, and the exponential. In each instance these three classes are treated from both the phenomenological and the microscopic aspect. In conclusion, a problem of particular interest to statisticians is presented which arises in failure theory. TAB

N66-31580# Joint Publications Research Service, Washington, D. C.
PREPARING OBJECTS FOR ELECTRON MICROSCOPES BY ETCHING WITH ACTIVE OXYGEN
M. R. Kiselev, E. I. Yevko, and V. M. Luk'yanovich *In its* Electron Microscopy and Met. Studies 23 Jun. 1966 p 53-55 (See N66-31575 18-26) CFSTI: $3.00

In order to investigate polymer materials using the electron microscope oxygen etching is proposed. The active oxygen is obtained using electrodeless high frequency discharge. To etch the specimen an attachment has been designed for the UVR-M vacuum station. Author

N66-31618*# Goodyear Aerospace Corp., Akron, Ohio.
INVESTIGATION OF FABRICATION AND PROCESSING PARAMETERS ASSOCIATED WITH USE OF POLYURETHANE FOAMS IN SEALED CRYOGENIC INSULATION
Final Report
C. B. Shriver 25 Jun. 1965 85 p
(Contract NAS3-5646)
(NASA-CR-72025; GER-12249) CFSTI: HC $3.00/MF $0.75
CSCL 11A

Several problems associated with the use of polyurethane foams in sealed cryogenic insulations were investigated. Fifteen 12-inch diameter perforated foam specimens were fabricated for evaluation in a thermal conductivity apparatus. Vacuum conditioning of foam at room and elevated temperatures to reduce outgassing was investigated. Several types of open cell foams were evaluated to obtain a desirable open cell rigid foam, and attempts made to rigidize several open cell flexible foams. Compression characteristics of open and closed cell foams were studied at room temperature and −320°F. Evaluation and fabrication methods using vapor barrier materials to seal polyurethane foam insulations were also investigated. Helium gas permeability tests using mass spectrometer techniques were conducted on various candidate vapor barrier materials and on selected adhesive candidates for vapor barrier material seams. Selected vapor barrier films were preconditioned to reduce outgassing of surface contaminants and evaluated by weight loss measurements in a vacuum environment. Vapor barrier film adhesive seam samples were evaluated for outgassing of a typical glue line edge by weight loss measurements in a vacuum environment. R.N.A.

N66-31733# Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
LEFKOWELD 109/LM-52 AND NARMCO 7343/7139 BOND STRENGTH TO 3D FOAM AT 25°C AND −196°C
G. M. Oliensis and H. E. Rumenapp 25 Aug. 1965 73 p
(SM-48414)

It is more economical to perform process control coupon tests at room temperature than at the cryogenic temperatures the part represented will experinece in service. This investigation was conducted to establish a correlation between room and cryogenic (−196°C) temperature tensile coupon values to take advantage of the test cost savings. Process control coupons identical to those fabricated with the installation of internal insulation in the Saturn S-IVB vehicles were made and tested so both the Lefkoweld 109 and Narmco 7343 adhesive systems used in production were individually compared at the two test temperatures. No correlation was found for Lefkoweld 109 between the corresponding test values obtained at the two test temperatures. A comparison of corresponding tensile strengths of Narmco 7343 test coupons resulted in a useable correlation for predicting cryogenic (−196°C) temperature values from room temperature tests. Author

N66-31838# Metaalinstituut TNO, Delft (Netherlands).
RESEARCH ON THE CAUSES OF TEARS IN TORQUE METER COVERS [ONDERZOEK VAN GESCHEURDE "TORQUE METER COVERS"]

W. Hagg 31 May 1966 14 p In DUTCH
(M-66-465; TDCK-45621) CFSTI: HC $1.00/MF $0.50

Visual, microscopic, and hardness tests were performed to determine the causes of radial tears originating at the screw holes in meter covers. Looseness of the bolt and screw thread deformation were also considered. From these test data, it was concluded that the tears were due to fatigue factors which, in turn, were due to the point type loads on the covers. The recommendation was made that future covers have larger screw holes. Transl. by J.O.

N66-31864# Library of Congress, Washington, D. C. Aerospace Technology Div.
MOLYBDENUM DISULFIDE-BASE SOLID LUBRICANTS Surveys of Foreign Scientific and Technical Literature
Charles Blomberg 11 May 1966 15 p refs Transl. into ENGLISH from Khim. i Tekhnol. Topliv i Masel (Moscow), no. 11, 1965 p 41-45
(ATD-66-52)

Since ordinary oils and greases cannot be used in these conditions of new technology, lubricants with new properties are now needed, i.e., solid lubricants. These are substances which possess a laminar structure and which ensure a sufficiently low friction coefficient between the coupled elements. Of the solid lubricants molybdenum disulfide, because of its special structure and a number of valuable properties, is finding increasingly wider application. The properties of molybdenum disulfide are discussed. The forms (powder, paste, solid lubricant coating and compact) in which solid lubricants can appear are listed and types which have been developed are enumerated. Paste concentrates are more convenient to use. Investigations are presented of the life and antifriction properties of solid film lubricants which are now industrially manufactured. The investigations were conducted in air, vacuum, and argon at extremely low temperatures and under radiation. The solid film lubricants which had the longest life are cited, as well as those in which the limit of working temperatures is increased to 500-600°C while in a vacuum of 10^{-5} torr and in argon; It was concluded that exposure to low temperatures and radiation with an integrated dose of 10^{8}-10^{9} radiation does not shorten the life of solid film lubricants. Author

N66-31871# Mitsubishi Heavy-Industries, Ltd., Nagasaki (Japan).
APPLICATION OF MULTIPLE REGRESSION ANALYSIS METHOD TO CUPOLA MELTING OPERATION
Shoji Tomita, Makoto Fukuda, Hiroshi Mizutani, Tokichi Yanagida, and Seiji Kumagai 1966 16 p refs In JAPANESE; ENGLISH summary *Its* Tech. Bull. No. 36
(MTB-010036) CFSTI: HC $1.00/MF $0.50

Cupola is one of the most common furnaces used for melting cast iron. But, on account of some variations of metal component, especially carbon and silicon, due to complicated reactions between raw materials, coke, slag, and various gases through out the furnace, it is difficult to establish the perfect control system of cupola operation and to get molten metal of proper chemical content. Recently, the application of multiple regression analysis method based on electric computer calculation, was introduced. Then we applied it to analysis of the data of our cupola from November 1962 to June 1965. The above mentioned analysis was achieved with the help of a digital computer (IBM 7044) and as a result: (1) significant factors which influence the deviation of carbon and silicon variation have been determined quantitatively so as to formulate the effective linear regression equation of high coefficient of multiple determination, (2) a special slide rule was devised and used for easier estimation of carbon and silicon variation at mixing calculation, and (3) quantitative estimations have been made possible for significant factors which have effects on tapping-temperature, slag basicity, and FeO% in slag. Author

N66-31872# India. Dept. of Atomic Energy, Bombay.
DEVELOPMENT OF U-FOAM AIR FILTERS
A. A. Khan, R. V. Amalraj, and K. T. Thomas 1966 30 p
(AEET-244) CFSTI: HC $2.00/MF $0.50

Prototype designs of U-foam air filters were developed. The units may be used as inlet air filters, prefilters along with high efficiency filters, or as filters in systems where the efficiency and other requirements are satisfied. The filter units are fairly temperature resistant under normal use in ventilation systems, but are neither fire resistant nor self-extinguishing. The filter is resistant to common inorganic acids, alkalies, and common organic solvents within specified limits. The pressure drops offered by the units are very low at rated capacities and efficiencies are fairly high. Dust loading of the filter units is expected to be high because of highly porous filter material. The filters can be used at much higher capacities with only a small decrease in efficiency. R.N.A.

N66-31893*# IIT Research Inst., Chicago, Ill.
INVESTIGATION OF THE EXPLOSION HAZARD OF CONTAMINATED DIFFUSION PUMP FLUIDS Final Report, 1 Jul. 1965-1 Jun. 1966
Jerry Farrell [1966] 87 p refs
(Contract NAS5-9632)
(NASA-CR-76525) CFSTI: HC $2.50/MF $0.75 CSCL 13K

This program was conducted to determine the effect of contamination of the explosion hazard potential of space simulation type diffusion pumps, to determine the type and quantity of contaminants present in the diffusion pump fluids, and to determine and compare the explosion limits of three used and three new DC-704 fluid samples. Results show the explosion limit temperature of the used DC-704 samples to be slightly lower than that of the new DC-704 fluid. The used fluids contained small amounts of metallic contamination such as aluminum, magnesium, and calcium. Several volatile components were found in the used fluids, and the new DC-704 was susceptible to air degradation at temperatures greater than 525°F. Ozone was detrimental to the stability of DC-704 in an operating diffusion pump. However, DC-704 was stable under conditions normally encountered in an operating diffusion pump even when metallic dusts and cleaning agents were present. R.N.A.

N66-31904*# Hittman Associates, Inc., Baltimore, Md.
THERMOELECTRIC BONDING STUDY, PHASE II Summary Report
Abraham L. Eiss Apr. 1966 107 p refs
(Contract NAS5-3973)
(NASA-CR-76512; HIT-205) CFSTI: HC $3.00/MF $0.75 CSCL 13H

This program was conducted to study the nature of the bond between lead telluride and commonly used electrical contact materials, to determine the mechanism causing the degradation and failure of lead telluride thermoelectric elements, and to develop a bonded lead telluride thermoelement with reliable long term performance. Two major mechanisms which caused failure in the bond zone were

diffusion of material from the braze into the thermoelectric material, and cracking caused by stresses resulting from the difference in thermal expansion between the thermoelectric and shoe material. It was demonstrated that p-PbTe is far more susceptible to both these phenomena than is n-PbTe. A reproducible technique for bonding lead telluride to iron shoes with a modified tin telluride braze was developed. The strengthening of p-PbTe was studied and life tests conducted to study the effect of time under operating conditions on the properties of bonded lead telluride thermoelements. R.N.A.

N66-32084# Frankford Arsenal, Philadelphia, Pa.
ULTRASONIC IN-PROCESS INSPECTION OF RESISTANCE SPOT WELDS Final Report
George E. Burbank and Wallace D. Taylor Apr. 1966 48 p refs
(FA-R-1811; AD-633340) CFSTI: HC $2.00/MF $0.50

In the continued evaluation of the in-process ultrasonic approach to the nondestructive inspection of resistance spot welds, ultrasonic through-transmission measurements were extended to several types of metals to establish signal sensitivity and behavior with respect to metallurgical changes. In addition, the test results are reviewed from the standpoint of meaningful trends and reproducibility required for the development of go-no go or absolute measurement type quality control devices. Author (TAB)

N66-32104# Springfield Armory, Mass.
RESONANT FREQUENCY METHOD FOR EVALUATION OF SINTERED POWDER METAL AND INVESTMENT CAST PRODUCTS
K. A. Fowler and H. P. Hatch 6 Mar. 1966 27 p refs
(SA-TR-19-1516; AD-632955) CFSTI: HC $2.00/MF $0.50

The initial phase of a continuing study of nondestructive test methods for potential application to sintered powdered metals is described. Measurements of natural mechanical resonant frequency and ultrasonic velocity have been successfully applied to the nondestructive evaluation of tensile strength of sintered iron test specimens. Empirical relationships between tensile strength and the velocity of sound propagation have been developed. These relationships are based on the fact that the disposition of residual porosity, which includes the size, shape, and distribution of the pores, simultaneously influences both the tensile strength and sonic velocity of sintered iron powder compacts. Author (TAB)

N66-32136*# Electro-Optical Systems, Inc., Pasadena, Calif.
DEVELOPMENT OF AN ELECTRODEPOSITION PROCESS FOR THE FABRICATION OF A SPHERICAL CRYOGENIC FLUID STORAGE CONTAINER
R. N. Hanson 30 Jun. 1966 55 p refs
(Contract NAS8-20094)
(NASA-CR-76640; EDS-6951-Final) CFSTI: HC $2.50/MF $0.50 CSCL 13H

A 51-inch-diameter, electrodeposited nickel, spherical pressure vessel was successfully designed, fabricated and tested. The results of this manufacturing process development study have proven the feasibility of fabricating seamless pressure vessels by the electrodeposition process. The vessel produced was fabricated by depositing nickel on an aluminum mandrel in a nickel sulfamate electroforming bath. The aluminum mandrel was removed after completion of the electroforming process by chemical etching with dilute hydrochloric acid. A hydrostatic proof test and helium leak test have shown the vessel meets the design requirements. Author

N66-32159# Aeroprojects, Inc., West Chester, Pa.
ULTRASONIC WELDING PROCESS AND EQUIPMENT FOR CONSTRUCTION OF ELECTRON-TUBE MOUNTS Quarterly Progress Report, Oct. 1-Dec. 31, 1965
J. G. Thomas [1965] 18 p
(Contract DA-36-039-SC-86741)
(QPR-14; AD-632364) CFSTI: HC $1.00/MF $0.50

Fabrication of a second sample lot of 100 type 6080WB electron tube mounts was successfully completed. Of 175 tube mounts started, 118 were completed up to the bulbing and basing operations. The final connection in the assembly sequence (snubbers to snubber support rods) was made by resistance welding, in order to utilize the more fragile alumina spacer now used in the 6080WB electron tube. The incidence of short circuits between the grid laterals and the cathode sleeve was eliminated by insertion of a steel mandrel in the cathode sleeve prior to welding. Author (TAB)

N66-32170# Naval Applied Science Lab., Brooklyn, N. Y.
FABRICATION AND PROPERTIES OF SIMPLE OPEN HAMMER, DIE, AND PRESS FORGINGS OF Ti-721 ALLOY
7 Jun. 1965 28 p refs
(TM-8)

This memorandum presents the results of initial studies to develop simple open hammer, die, and press forging data for the Ti-721 alloy as part of a program being conducted to develop procedures for forming components of heavy section titanium alloy to be used in the construction of pressure hulls for deep diving submersibles. Ti-721 alloy forgings were fabricated in a shipyard forge shop, examined for surface defects, and evaluated for soundness and mechanical and metallurgical properties. Results showed that simple hammer, die, and press forgings of Ti-721 alloy can be produced without difficulty with conventional shipyard forging equipment. Mechanical properties exceeding requirements were obtained with material forged from below the beta transus temperature and also with forged material annealed at 1650°F after forging. A comparison of these properties is tabulated. Scaling problems with the alloy are not severe when the material is forged in air at temperatures close to the beta transus temperature. Hot forming of welded Ti-721 alloy plate appears feasible but needs further development to preclude fissuring in severely deformed sections. R.N.A.

N66-32177# General Electric Co., Cincinnati, Ohio. Advanced Engine and Technology Dept.
APPLICATION OF ADVANCED FIBROUS REINFORCEMENT COMPOSITE MATERIALS Monthly Progress Report, 1-31 Jan. 1966
[1966] 101 p refs
(Contract AF 33(615)-3262)

This report describes progress made on the development of polymer and metallic base boron composites; component analysis, design, and fabrication; test data, and program studies. Engine weight reductions resulting from direct materials substitutions are being derived and show improvements in airframe efficiencies. Increased range and payload studies resulted in preliminary improvement values. Boron filament surface treatments improve its composite properties. Effects of glass interleaving, cure cycles, and thermal gradients during the cure of polymer matrix composites are being evaluated. Test specimens were fabricated and testing started to obtain property data for design use. Increased V/O metal matrix specimens were fabricated and tested. The higher boron content causes failure by filament fragmentation in the specimen grip area during test. Trial fabrication and tool modification efforts for individual blades are continuing. A second spin test of the first integrally bladed compressor disc

was conducted. The failure mode indicates the need for pedestals at the blade roots to restrain the filaments are to prevent their failure. The layup configuration for Lot II stator vane was defined. R.N.A.

N66-32203# General Electric Co., Cincinnati, Ohio. Advanced Engine and Technology Dept.
APPLICATION OF ADVANCED FIBROUS REINFORCEMENT COMPOSITE MATERIALS Monthly Progress Report, 1-31 Dec. 1965
20 Jan. 1966 50 p
(Contract AF 33(615)-3262)
(MPR-3)

Work accomplished on a program design to demonstrate the application of advanced fibrous reinforced composite materials to jet engine components is discussed. The components selected include a compressor fan blade, a compressor stator vane, and an integrally bladed compressor disk. The development status of the development of polymer and metallic base boron composites is given; as well as the status of component analysis, design, and fabrication; test data; and program studies. The objectives, accomplishments, and future plans of the various areas of activity are presented. Tables, schematic diagrams, and graphs are included. L.S.

N66-32211# Wisconsin Univ., Madison. Engineering Experiment Station.
INVESTIGATION OF CUTTING TOOL TEMPERATURE PREDICTION EQUATION
S. M. Wu, R. N. Meyer, and L. P. Remer Jan. 1965 81 p refs
Sponsored by Am. Soc. of Tool and Mfg. Engr. and by Wis. Alumni Res. Found.
(Rept.-30)

A temperature predicting equation for cutting tools is developed by taking logarithmic transformations of the dependent and independent variables and applying regression analysis to determine the best fit of the parameters. Although logarithmic transformations appear to be adequate in linearizing these variables, they may not be the best power transformation. A mathematical analysis using general power transformations for three of the variables is therefore also investigated. The experimental setup for temperature measurement and calibration, and the technique of statistical experimental design and analysis are presented in detail. K.W.

N66-32297*# Boeing Co., Seattle, Wash.
IDENTIFYING OPTIMUM PARAMETERS OF HOT EXTRUSIONS Progress Report No. 9, 1 May-15 Jul. 1966
[1966] 13 p refs
(Contract NAS7-276)
(NASA-CR-76742) CFSTI: HC $1.00/MF $0.50 CSCL 13H

Continuing research on optimum parameters of hot extrusions is reported. The construction of a new furnace for heating billets is discussed, and preparation of billets for four extrusions is described. Fracture analysis of extruded specimens is covered. Composite photographs illustrate a complex fracture originating from one (or more) grain boundary surfaces approximately parallel to the fracture surface. Some room temperature tests with the bi-crystal boundaries parallel to the tensile axis were made. Specimens were annealed at 3600°F, chemically polished, and tested. These all failed by cleavage, as expected, even when the cleavage angle to the tensile axis was high. Photographs illustrate the failure tensile surface, and fracture surface of MgO bi-crystals. L.E.W.

N66-32312# Marine Engineering Lab., Annapolis, Md.
SELF-LUBRICATED COMPOSITE MATERIALS FOR HIGH-PRESSURE AIR SEALS (FILAMENT-WOUND STRUCTURES)
Harry Halliwell and J. R. Ward May 1966 31 p refs
(MEL-56/66; AD-633238) CFSTI: HC $2.00/MF $0.50

In a continuing program to exploit the unusual properties and potential advantages of solid composite lubricants, a sleeve-type seal based on reinforced polytetrafluoroethylene was developed as a piston seal for high-pressure air compressors. The status of the material development for maximizing the effectiveness and life of this seal is reported. Specifically considered is the use of an organized metallic filament-winding technique to provide a superior reinforcing matrix as compared to the randomly dispersed particles and fibers used heretofore. New approaches to combinations of composites for this and other applications have been uncovered. It is possible to expect reliable compressor operation at 5000 psi using such seals in lieu of conventional split rings for periods beyond 1000 hours with very low rates of wear and air leakage. Author (TAB)

N66-32418# Joint Publications Research Service, Washington, D. C.
MANUFACTURE OF CAST MICROWIRE WITH GLASS INSULATION
V. A. Shipirnov 25 Jul. 1966 12 p Transl. into ENGLISH from the pamphlet "Litaya Provoloka" Moscow, Znaniye Publishing House, 1966 p 25-28
(JPRS-36664; TT-66-33095) CFSTI: $1.00

A method is described for producing cast microwire directly with glass insulation. This method has the advantage that the diameter of the metallic strand can be reduced to 1 to 2 microns or less. Also, this method makes it possible to produce microwire from brittle metals and alloys (cast iron, germanium, etc.), and from metals and alloys of low strength (for example, tin). This microwire is obtained from a drop of liquid metal placed in an oscillating circuit in a glass tube, from which is extruded a microcapillary filled with metal. C.T.C.

N66-32434*# Reynolds Metals Co., Richmond, Va. Finishing and Composites Section.
A SPRAY OR BRUSH ANODIZING PROCESS FOR ALUMINUM ALLOYS Six-Month Progress Report
Harold J. Coates 20 Jun. 1966 58 p refs
(Contract NAS8-20157)
(NASA-CR-76758; MRD-35-170-820) CFSTI: HC $2.50/MF $0.50 CSCL 13H

The initial research to develop a spray or brush anodizing process for aluminum alloys has been completed. The principal objectives in this phase were centered around the investigation of anodizing parameters of the aluminum alloy 2219 and the evaluation of coating quality on the samples produced. This information was gathered and used to formulate a spray anodizing process. The study has covered anodic coating studies, electrolyte flow rate relationships with other anodizing variables, pretreatment and post treatment effects, and materials. It has been found that 2219 can be anodized at current densities of 800 amps/ft^2 or more under the proper conditions of the electrolyte type, concentration, temperature, and flow rate. The concept of spray anodizing 2219 has been proven feasible by the establishment of the proper anodizing conditions. Author

N66-32476# National Lead Co. of Ohio, Cincinnati. Feed Materials Production Center.
DESIGN AND OPERATION OF A VACUUM CATHODIC ETCHING UNIT

W. N. Wise May 1966 16 p
(Contract AT(30-1)-1156)
(NLCO-971) CFSTI: HC $1.00/MF $0.50

The design, construction, and operation of a vacuum cathodic etching instrument are discussed. A special feature of the design is a liquid-cooled zirconium cathode with a horizontal surface for supporting the sample. Both mounted and unmounted uranium metal samples can be etched in 30-minute cycles using argon as the bombarding gas.

Author (NSA)

N66-32538# Lockheed Missiles and Space Co., Sunnyvale, Calif.

LUBRICATION EVALUATION

Francis J. Clauss Apr. 1966 125 p refs

The performance of various types of lubricants on ball bearings operating in a simulated space environment was evaluated, including oils, greases, bonded films of solid lubricants, and composites of self-lubricating materials. The lubricants were evaluated on lightly loaded, instrument sized ball bearings operating at 8000 rpm. Simulated space conditions included vacuum to 10^{-9} torr, temperatures up to 300°F, and radiation doses up to 4×10^7 R. General conclusions reached include: operation in vacuum can drastically reduce lubricant lifetime below that obtained for operation in air; oils and greases provide the best type of lubrication for ball bearings exposed to vacuum; ball bearing lifetime with oil lubrication increased with viscosity, which was most pronounced at low viscosities; bearing failures were preceded by lubricant failures; and ball bearings with retainers of reinforced Teflon operated successfully in vacuum for over 10,000 hr with light bearing loads. Tests were also conducted to evaluate the performance of various bonded solid film lubricants under conditions of sliding friction in air, and results were tabulated. The friction and adhesion of metals is also discussed, in reference to cold welding under vacuum conditions of space. L.E.W.

N66-32638*# Pratt and Whitney Aircraft, West Palm Beach, Fla. Research and Development Center.

INVESTIGATION OF PRESSURE PREDICTION METHODS FOR LOW FLOW RADIAL IMPELLERS Final Report

W. E. Young and H. F. Due 4 Feb. 1966 78 p refs
(Contract NAS8-5442)
(NASA-CR-76947; PWA-FR-1716) CFSTI: HC $2.50/MF $0.75 CSCL 13K

The effect of changes in geometry and operating conditions on the radial pressure distribution along the low flow back face of centrifugal pump impellers is investigated; and a computer program is formulated for predicting pressure distribution. Supplementary data are presented on incompressible flow studies using water and liquid hydrogen as test fluids; and an additional configuration of a smooth disk with bladed housings is introduced. Data include pressure measurements at the inlet, exit, and at several radial locations on both the front and back faces. These measurements are used to develop regression equations for the fluid velocity ratio, K, (ratio of fluid angular velocity to wheel speed) for each configuration. Regression equations are combined in a Fortran computer program for use on the IBM 7090 computer. The program will determine the K value for a given configuration and set of operating conditions, and apply this value to the forced vortex equation to compute the pressure distribution on the back face of the impeller. S.P.

N66-32683*# Harvey Aluminum, Torrance, Calif. Engineering Labs.

DEVELOPMENT OF CONTROLS FOR TIME–TEMPERATURE CHARACTERISTICS IN ALUMINUM WELDMENTS Progress Report No. 9, 1–31 Dec. 1965

D.Q. Cole 10 Jan. 1965 24 p
(Contract NAS8-11930)
(NASA-CR-76910; HA-2209) CFSTI: HC $1.00/MF $0.50 CSCL 13H

A summary of accomplishments during a two-phase research program to develop methods, tooling concepts, and processes to control the time–temperature characteristics in the weld and heat affected zone, in order to improve tensile properties and reduce porosity in aluminum weldments, is presented. Equipment has been modified, with instrumentation installed to monitor welding variables. An evaluation of infrared radiometers for application to the program is in progress, and some favorable results are indicated. Tentative thermal patterns for comparison of chilled and unchilled weldments have been obtained. These patterns show that chilling with liquid CO_2 substantially increases the cooling rate of weldments in both 5/16" and 1/2" 2014-T6 plate. Macrosections show reduced width of heat affected zone and smaller grain size for chilled weldments. Author

16 MASERS

Includes applications of masers and lasers. For basic research see: 26 Physics, Solid State.

N66-31537# Westinghouse Electric Corp., Pittsburgh, Pa. Quantum Electronics Dept.

ARC DISCHARGE SOURCES Semiannual Report, 16 Oct. 1965–15 Apr. 1966

Charles H. Church, Richard G. Schlecht, I. Liberman, B. W. Swanson, and E. Geil 15 May 1966 92 p refs
(Contract Nonr-4647(00); ARPA Order 306-62; Proj. Defender)
(AD-632892) CFSTI: HC $3.00/MF $0.75

Research is directed towards explaining quantitatively the pulsed arc xenon discharges used for the optical pumping of high energy lasers. A complete explanation of these discharges requires information on the physical properties of the xenon arc plasma as a function of temperature and pressure. Electrical conductivity of high density xenon plasmas, by R. G. Schlecht, C. H. Church, and I. Liberman. The electrical conductivity of a high density pulsed arc discharge in xenon has been measured. The experimental results agree very well with the Spitzer theory in the region of 1.6 to 2.5 particles per Debye sphere where the Kihara, Aono and Itikawa theory should be much better. Studies of highly radiative plasmas using the wall stabilized pulsed arc discharge, by C. H. Church, R. G. Schlecht, I. Liberman, and B. W. Swanson. Plasmas with pressures exceeding one atmosphere and power densities to 300,000 watts/cu cm have been created in a confined pulsed arc discharge in xenon. Theoretical models for the arc have been studied for the cases for which a major portion of the input power is radiated in the optically thin spectral regions using a homogeneous temperature model. For the optically thick radiation and/or thermal conduction being dominant, techniques for solving integral differential power balance equation are being developed. TAB

N66-31850*# National Aeronautics and Space Administration. Washington, D. C.
THE LASER
[1966] 8 p
(NASA Facts, Vol. III, No. 6) GPO: $0.10 CSCL 20E

A simple brief discussion of laser technology is presented. Pictures are included to illustrate the various types of lasers and their operation in the areas of space communications, industry, and navigation. Use of lasers for optical radar and space tracking on Explorer satellites is also described. Private industry, medicine, chemistry, and metallurgy are mentioned as potential users of lasers. S.P.

N66-32075*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
PULSED-LASER RANGING
T. S. Johnson *In its* Publ. of Goddard Space Flight Center, 1963, Vol. II [1963] p 876-879 (See N66-32044 18-31)
CFSTI: HC $7.00/MF $5.00

Pulsed ruby laser signals for satellite tracking were tested by an analog measuring system utilizing a delayed-sweep oscilloscope as the time-measuring device, and also with a digital system employing a high-resolution time-interval unit. Tracking cine-theodolite telescopes with a clear aperture area of about 275 cm^2 were used as receivers, and attenuating filters were installed in the laser transmitter to simulate the reflected signal. Operational tracking tests found the analog measuring system impossible to operate because of rapid changes in the length of required delay; however, in normal sweep operations, the oscilloscope performed well as a gross monitoring system. The digital system, consisting of a 10-Mc counter with a time-interval unit, a digital clock, and a printout unit performed well but was stopped by backscatter from beam attenuation. G.G.

N66-32076*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE S-66 LASER TRACKING EXPERIMENT
H. H. Plotkin *In its* Publ. of Goddard Space Flight Center, 1963, Vol. II [1963] p 880-884 (See N66-32044 18-31)
CFSTI: HC $7.00/MF $5.00

Presented are numerical calculations for an optical satellite tracking experiment that uses Q-switched rubidium laser signals to illuminate special reflectors attached to satellites, receives the reflected light, measures the time of flight for range, and autotracks the reflected pulse to obtain angle coordination as well. Numerical estimates of expected signal reflections show that a pulse of 1 joule from a ruby laser, attenuated to 0.8 in each passage through the atmosphere, is reflected by a 2000 cm^2 mosaic array of small retroreflectors at a range of 1500 km, within a cone of 10^{-4} radian diameter, and can be received in a telescope aperture area of about 500 cm^2. G.G.

N66-32219# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
INVESTIGATION OF THE LASER-STIMULATED DEPOSITION OF THIN FILMS: PROJECT DEFT Final Report, Feb. 1965-Feb. 1966
R. J. Clark, Jr. Mar. 1966 50 p refs
(UD-2037-E-1; AD-482474)

A study was made of the capability of a ruby laser to cause the evaporation of metals in order to initiate thin-film deposition. It was shown experimentally that a high degree of thermal excitation exists within the laser-generated vapor, which inhibits the coalescence of the vapor on the surface. The amount of energy in the plume has been determined, but the mechanism of its production is unknown. Author (TAB)

N66-32437*# Carnegie Inst. of Tech., Pittsburgh, Pa.
A NOTE ON THE THERMODYNAMICS OF LASERS
R. L. Longini [1964] 12 p refs
(Contract NAS8-5269)
(NASA-CR-76761) CFSTI: HC $1.00/MF $0.50 CSCL 20E

The suggestion that injection lasers may remove heat from their environment and convert it into light is discussed from the viewpoint of the limits of thermodynamic efficiency which must be achieved before cooling can result. The critical temperatures involved are defined in order to determine how much of the energy of the photon system can be supplied by the phonons. Analytical methods are described, and it is shown that there are equivalent temperatures which can be put into thermodynamic terms of the laser structure and the heat sink. A.O.

N66-32449# Los Alamos Scientific Lab., N. Mex.
DESIGN AND USE OF A HIGH POWER LASER FOR PLASMA GENERATION STUDIES
Phillip N. Mace 1 Apr. 1966 56 p refs
(Contract W-7405-ENG-36)
(LA-3369) CFSTI: HC $3.00/MF $0.50

The advent of high power lasers to the technological scene has introduced the possibility of creating new effects utilizing the interaction of this high intensity light with matter. C. M. Fowler and D. B. Thomson of LASL suggested in 1963 the possibility of using a high power laser to preionize and heat a target material to be contained in an explosively driven theta pinch machine. Consequently an effort was undertaken to design and build a suitable laser for some feasibility studies. A 50-MW laboratory laser was built; however, it became possible to use a higher power commerical laser which had the advantage of being more nearly a "tool" rather than a "breadboard" device, and was therefore more amenable to experimental investigation of laser-produced plasmas. This laser was used to produce plasmas in a thin polyethylene target. A two-coil magnetic field system was built to allow the investigation of magnetic containment problems. The following measurements were made: (1) high speed framing camera photographs of the plasma, (2) still 35 mm camera photographs using Kodak X-R type film, (3) spectrographic measurements using a Hilger medium quartz non-time resolved spectrograph, (4) gas laser light absorption measurements, (5) individual spectral line intensity vs time measurements using a Jarrell-Ash monochromator, and (6) ion energies using an optical time-of-flight measuring technique. The results indicate that a plasma having a "temperature" of a few electron volts and a directed energy of several kiloelectron volts is produced by the laser beam. The discrepancy between the thermal energy and the directed energy is attributed to the lack of thermal equilibrium in the plasma. The application of a 20 kilogauss magnetic field increases the apparent "temperature" of the plasma and reduces the directed energy. The feasibility of producing a highly ionized plasma in a moderately low-Z target was demonstrated. Further studies of simpler atomic systems are recommended, particularly in conjunction with more highly refined measurements of plasma temperature, density, and containment effects. Author (NSA)

N66-32458# Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.
LASER: A DEPLETION PROGRAM FOR LATTICE CALCULATIONS BASED ON MUFT AND THERMOS
C. G. Poncelet Apr. 1966 103 p refs
(Contract AT(30-1)-3017)
(WCAP-6073) CFSTI: HC $4.00/MF $0.75

LASER is a one-dimensional (cylindrical), multi-energy (85 groups) lattice-cell program which is based on the MUFT and THERMOS codes. The thermal cutoff is 1.855 eV. A burnup option is provided. The program will, at option, account for the nonlinear effects in the burnup equations. The spatial burnup distribution within the fuel rods is explicitly calculated. The output is quite extensive and includes, in addition to the normal edits, an edit for the energy range $0 \leq E \leq 0.625$ eV. The physical and mathematical formulations of the model are outlined and a general description of the program, including a description of the input and output data is included. LASER is written in FORTRAN IV for the IBM 7090/7094/7094. Author (NSA)

N66-32684*# Smithsonian Astrophysical Observatory, Cambridge, Mass.
SATELLITE TRACKING WITH A LASER
C. G. Lehr 20 Jun. 1966 66 p refs
(Grant NsG-87-60)
(NASA-CR-76902; SAO Special Rept.-215) CFSTI: HC $2.50/MF $0.75 CSCL 20E

For satellite tracking, laser systems have characteristics that supplement the capabilities of Smithsonian's Baker-Nunn cameras. A laser system can measure range. It can operate when a satellite is in the earth's shadow. It can range on a satellite when the sky is too bright for the Baker-Nunn cameras. The range equation and the statistics of the background noise are used to analyze a laser system. The results are applied to the experimental system now in operation at the Smithsonian astrophysical observing station in New Mexico. Ranging at night and during the day is considered for satellites with retroreflecting mirrors. The laser energy needed to photograph such a satellite in the earth's shadow is computed. Calculations show that the present system can only range on satellites that incorporate retroreflectors; however, commercially available components could be used to build a system that should obtain a return signal from a large noncooperative satellite like Echo 2. Author

17 MATERIALS, METALLIC

Includes cermets; corrosion; physical and mechanical properties of materials; metallurgy; and applications as structural materials. For basic research see: 06 Chemistry. For related information see also: 18 Materials, Nonmetallic; and 32 Structural Mechanics.

N66-31544# Pennsylvania Univ., Philadelphia. Electrochemistry Lab.
HYDROGEN EMBRITTLEMENT RESULTING FROM CORROSION, CATHODIC PROTECTION AND ELECTROPLATING Quarterly Report, Dec. 1965-Feb. 1966
E. Gileadi and M. Fullenwider 7 Mar. 1966 13 p refs
(Contract N156-46659)
(QR-3; AD-633402) CFSTI: HC $1.00/MF $0.50

The concentrations of hydrogen determined by the method of charging-up followed by pulling-out of hydrogen with the Barnacle Electrode were found to vary between 2 and 6×10^{-6} moles cm^{-3}, depending upon the conditions of polarization. these concentrations were calculated with an approximation, good for small times, the mathematics of which is outlined briefly. TAB

N66-31652# Northwestern Univ., Evanston, Ill. Dept. of Materials Science.
PRECIPITATION IN CERAMICS
Morris E. Fine *In* Office of Aerospace Res. Proc. of the OAR Res. Appl. Conf. [1966] p 101-116 refs (See N66-31646 18-34) CFSTI: HC $5.00/MF $1.00

A discussion is given of fundamental research in the precipitation of ceramics. Emphasis is placed on alloying and heat treating ceramic oxides, with basic research conducted with NaCl, MgO, and Mg-Fe-O ceramics. The studies include mechanical property determinations, magnetic properties research, and discussions of the various applications of the precipitated ceramics. C.T.C.

N66-31667*# General Technologies Corp., Alexandria, Va.
A STUDY OF LOW DENSITY, HIGH STRENGTH HIGH MODULUS FILAMENTS AND COMPOSITES
J. A. Alexander, R. G. Shaver, and J. C. Withers Washington, NASA, Jul. 1966 27 p refs
(Contract NASw-1020)
(NASA-CR-523) CFSTI: HC $2.00/MF $0.50 CSCL 11D

The fabrication and testing of three types of advanced composite materials: 1) metals reinforced with continuous filaments, 2) metals reinforced with single crystal whiskers, and 3) multilaminar composites consisting of alternate layers of metal and ceramic, are described. Boron carbide and silicon carbide filaments were synthesized for the filament composites. Electrodeposited nickel was reinforced by both 4 v/o tungsten wire and 20-30 v/o boron filament in aligned configuration. Tensile testing of these composites yielded tensile strengths in all cases that exceeded theoretical values calculated by adding the volume-weighted tensile strengths of the components. The effect was most pronounced with the boron filament. The fabrication and testing of sapphire whisker composites of powder metallurgically produced Al-6Si matrix and electrodeposited nickel is also discussed. Work was also carried out on techniques for depositing niobium and aluminum films to form alumina-niobium multilaminar composites, but no composite specimens were fabricated. L.S.

N66-31769*# Little (Arthur D.), Inc., Cambridge, Mass.
THE PEST PHENOMENON IN INTERMETALLICS Final Report, Period Ending 4 Mar. 1966
May 1966 31 p refs
(Contract NASw-1167)
(NASA-CR-76427) CFSTI: HC $2.00/MF $0.50 CSCL 11F

Intermetallic testing was conducted to induce pest in single crystals by application of a bending stress. While preliminary findings indicated that stress-free single crystals of molybdenum disilicide ($MoSi_2$) do not pest, analytical results show that the pest phenomenon is related to the phenomenon of static fatigue or delayed failure in brittle materials. Single crystals of $MoSi_2$ exhibited delayed failure or static fatigue

under pesting conditions (450°–600°C in an oxidizing atmosphere), but pest reaction was induced in single crystals which were statically loaded in bending. Polycrystals of $MoSi_2$ measured for thermal expansion by high-temperature X-ray diffraction failed to show any large anisotropy. R.Ll.

N66-31967# Joint Publications Research Service, Washington, D. C.

ALUMINUM–BERYLLIUM BASE ALLOYS

I. N. Fridlyander, K. P. Yatsenko, Z. G. Semenova, and G. A. Nekrasova 11 Jul. 1966 10 p refs Transl. into ENGLISH from Metalloved. i Term. Obrabotka Metal. (Moscow), no. 3, Mar. 1965 p 2–5

(JPRS-36415; TT-66-32847) CFSTI: $1.00

Methods are discussed for improving the specific modulus of elasticity and other mechanical properties of aluminum–beryllium base alloys. These include various thermal processes and heat treatments, the addition of nonmetals and other metals, cold deformation, hot pressing, and annealing. Both sheet and structural forms of the alloy are considered. D.T.

N66-32000# Case Inst. of Tech., Cleveland, Ohio.

EFFECT OF DUCTILE CLADDING ON ROLLED TUNGSTEN

Gordon K. Watson (M.S. Thesis) Jun. 1966 58 p refs

A ductile copper cladding was successfully applied to tungsten sheet by hot roll bonding as determined by tensile, bend, peel and metallographic tests. The effect of cladding thicknesses up to 0.020 inch on the transition temperature as measured by bend tests was determined. The tensile strengths of the clad composites were also investigated. The cladding reduced the bend transition temperature in both the longitudinal and transverse directions; the greater decrease was in the transverse direction. The cladding had no apparent effect on tensile ductility. Explanations of these effects are proposed. Author

N66-32137*# Sherwin-Williams Co., Cleveland, Ohio.

DEVELOPMENT OF IMPROVED CONVERSION COATING FOR USE WITH CORROSION-INHIBITING WHITE PRIMER Final Technical Report, 1 Mar.–15 Sep. 1965

Charles R. Martens and Roger S. Downing 6 Jun. 1966 16 p refs

(Contract NAS8-11788)

(NASA-CR-76638) CFSTI: HC $1.00/MF $0.50 CSCL 11F

An improved chromate conversion coating was developed to increase the corrosion resistance in a white paint primer, and to withstand testing in a salt spray atmosphere. Experimental results on preliminary data obtained were checked by a statistically designed experiment, and reinforced the conclusion that a suitable chemical pre-treatment of the aluminum alloy improves the performance of a subsequently applied chromate conversion coating. A salt spray life of 237 hours for the optimum coating schedule was predicted, which suggests the process described could be the means of satisfactorily protecting the alloy. R. Ll.

N66-32157# Massachusetts Inst. of Tech., Cambridge. Dept. of Metallurgy.

RELATIONSHIP BETWEEN PAIR POTENTIALS AND DISTRIBUTION FUNCTIONS Technical Report No. 7

S. L. Strong and Roy Kaplow 6 Apr. 1966 14 p refs

(Contract Nonr-1841(48))

(DSR-7954; AD-633050) CFSTI: HC $1.00/MF $0.50

It is demonstrated that the relationship between pair potentials and distribution functions is experimentally ambiguous for dense fluids. Calculations in the Percus–Yevic approximation show that qualitatively different potentials can be chosen which predict pair distributions which are virtually indistinguishable, and vice-versa. In addition, if the nearest neighbor interaction is predominant, it appears that the assumption of symmetric interactions may not be valid in liquids such as mercury and tin. Author (TAB)

N66-32158# Institute of Modern Languages, Inc., Washington, D. C.

STRUCTURE AND MORPHOLOGY OF THE HYDROXIDE LAYERS OF THE ALUMINUM SURFACES

Von H. Ginsberg and K. Wefers Ft. Belvoir, Va., Army Eng. Res. and Develop. Labs., Apr. 1966 32 p Transl. into ENGLISH from Aluminium (Dusseldorf), v. 37, 1961

(Contract DA-44-009-AMC-1563(T))

(ERDL-T-1838-66; TT-66-61088; AD-631432) CFSTI: HC $2.00/MF $0.50

Studies of surface layers of aluminum hydroxide by means of light optical microscopy, electron microscopy, X-ray diffraction analysis, infrared spectroscopy, and differential thermoanalysis are described; and the results and their significance are discussed. Special attention is given to the effect of handling temperature on the formation of hydroxide layers and their properties. (TAB)

N66-32160# Northwestern Univ., Evanston, Ill. Dept. of Materials Science.

THE SUBSTRUCTURE, STORED ENERGY, AND PROPERTIES OF SHOCK-LOADED COPPER

D. C. Brillhart, R. J. De Angelis, A. G. Preban, J. B. Cohen, and P. Gordon (Illinois Inst. of Technol.) 11 Apr. 1966 35 p refs

(Contracts Nonr-1228(20); Nonr-1406(03))

(TR-10; TR-14; AD-632456) CFSTI: HC $2.00/MF $0.50

Changes in stored energy, resistivity, density, X-ray line broadening and dislocation arrangements (from transmission electron microscopy) have been measured on Cu specimens shock-loaded at 75–435 kb. The stored energy in shock-loaded copper, and changes in density and resistivity are larger than those after conventional deformation. A high density of twins makes an appreciable contribution to all the measured quantities. Dislocation densities rise to values of 10^{11} lines per cm^2 at the highest pressure. The resistivity, density and X-ray measurements yield dislocation densities in substantial agreement at all pressures, after correcting for the effects due to the twins. At the higher pressures electron microscopy yields results that are lower by a factor of about 5–10. Dislocation densities from stored energy measurements are high; this finding can be rationalized by the consideration that the deformation twin boundaries present are largely incoherent. There is no evidence for homogeneous dislocation nucleation during shock-loading. Author (TAB)

N66-32164# Columbia Univ., New York. Henry Krumb School of Mines.

ANELASTIC TECHNIQUES: IRON, A CASE HISTORY

Daniel N. Beshers 1965 55 p refs Submitted for Publication

(Contract Nonr-266(61))

(TR-7; AD-625912) CFSTI: HC $3.00/MF $0.50

Internal friction is defined and discussed rather generally. To illustrate the applicability of the method, the numerous

phenomena observed in iron are reviewed. The results of recent low temperature experiments are compared, leading to suggested correlations among the observations. Author

N66-32184# Syracuse Univ. Research Inst., N. Y. Dept. of Chemical Engineering and Metallurgy.
CRACK INITIATION IN METALLIC MATERIALS Quarterly Report, 1 Jun.-30 Nov. 1965
V. Weiss, G. Krause, C. Chave, Jr., and G. Marchetto Jan. 1966 20 p
(Contract NOw-65-0355d)
(MET.-E.-1289-1566P2-3)

Progress is reported on the development of an acoustic detection method for determining crack initiation and propagation in metallic materials. Since the previous pickup arrangement seemed insufficient, a new compensation method for acoustic detection was used which has a good signal to noise ratio and directly gives an acoustic signal versus load diagram on the screen of a storage oscilloscope. This recording system is described in detail and examples of typical first fracture-sound records are discussed. The measuring setup was tested in connection with a vacuum environment chamber which is used to standardize different specimens before changing the environment. R.N.A.

N66-32186*# TRW Systems, Redondo Beach, Calif.
INVESTIGATION OF TWO-PHASE TUNGSTEN-RHENIUM ALLOYS FOR IONIZER APPLICATIONS, VOLUME II Final Report
M. E. Kirkpatrick and R. A. Mendelson Jul. 1966 33 p refs
(Contract NAS3-7109)
(NASA-CR-54694; TRW-4429-6012-RO-000, Vol. II) CFSTI: HC $2.00/MF $0.50 CSCL 11F

The development of porous materials from a cast two-phase alloy of tungsten-rhenium has been investigated in detail with regard to its suitability and applicability to porous ionizer materials. The laboratory program involved a study of the microstructure as a function of alloy composition over the range from 25 to 45 weight % Re. It was demonstrated that alloys in the range of 36 to 38 weight % Re had optimum proportion and configuration of the tungsten solid solution and the sigma phase alloy components. An extensive investigation into phase removal techniques for removing the sigma phase component are reported and indicate an electrolytic etching technique to be optimum in terms of reproducibility and efficiency. Cesium ionization tests were performed using a button-shaped emitter having a diameter of approximately 1/8 inch and a discussion of the ionizer test results is discussed. Author

N66-32216# Army Materials Research Agency, Watertown, Mass. Materials Engineering Div.
ADHESION AND THERMAL PROPERTIES OF REFRACTORY COATING-METAL SUBSTRATE SYSTEMS
Milton Levy, Gilbert N. Sklover, and David J. Sellers Jan. 1966 30 p refs
(AMRA-TR-66-01; AD-482760)

The U.S. Army Materials Research Agency Program for evaluating the adhesion of oxyacetylene- and arc-plasma-sprayed metal, ceramic, and cermet coatings to various substrate metals, their resistance to thermal shock, and their drop or insulative properties is described in detail. Adhesion, thermal shock and drop data, and emittance values for these coating substrate systems are presented and evaluated along with X-ray diffraction analyses of coating materials before and after deposition. Author (TAB)

N66-32264*# Lehigh Univ., Bethlehem, Pa. Inst. of Research.
INVESTIGATION OF THE SOLIDIFICATION, STRUCTURE AND PROPERTIES OF EUTECTIC ALLOYS INCLUDING CONSIDERATION OF PROPERTIES CONTROL Second Semiannual Progress Report
R. W. Hertzberg and R. W. Kraft 14 Jul. 1966 17 p refs
(Grant NGR-39-007-007)
(NASA-CR-76668) CFSTI: HC $1.00/MF $0.50 CSCL 11F

This report contains brief statements of the objectives, plans, and status of several separate but related research programs being conducted on the solidification, structure, and properties of controlled eutectic alloys. These include studies of microstructural stability of a fibrous Al-$NiAl_3$ eutectic at high temperatures, a high temperature Ni-Ni_3Nb eutectic alloy, the mechanical properties of an Al-$CuAl_2$ eutectic, the fatigue behavior of an Al-Al_3Ni eutectic, and the phycical property measurements of the Bi-Zn eutectic alloy. R.N.A.

N66-32331*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COMPATIBILITY OF TANTALUM, COLUMBIUM, AND THEIR ALLOYS WITH HYDROGEN IN PRESENCE OF TEMPERATURE GRADIENT
Joseph R. Stephens and Ralph G. Garlick Washington, NASA, Aug. 1966 25 p refs
(NASA-TN-D-3546) CFSTI: HC $1.00/MF $0.50 CSCL 11F

An investigation on the compatibility of tantalum and columbium with hydrogen in the presence of a temperature gradient was conducted to determine the suitability of these materials for use in a hydrogen-cooled nuclear rocket nozzle. Specimens having a temperature gradient from room temperature to approximately 3000°F were heated in a hydrogen atmosphere, held for a predetermined time, and cooled in hydrogen at rates from 25° to 1500°F per minute. Results showed that neither tantalum nor columbium is compatible with hydrogen under these conditions. Results also indicated that available commercial alloys of tantalum and columbium were not compatible with hydrogen under the imposed test conditions. An attempt was made to reduce the solubility of hydrogen in tantalum or columbium by alloying with rhenium to increase the electron-atom ratio. Results from tantalum-rhenium alloys indicated that at an electron-atom ratio of 5.5 (25 at. % Re) hydrogen absorption was reduced from 40.8 to 0.2 atomic percent for unalloyed and alloyed tantalum, respectively. It is concluded that unalloyed tantalum and columbium and their commercially available alloys are unattractive for use in hydrogen under conditions similar to those anticipated in nuclear rockets because of severe hydrogen absorption and embrittlement. Author

N66-32352# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
IMPROVED POSTIRRADIATION TENSILE PROPERTIES OF HASTELLOY X-280
I. S. Levy and K. R. Wheeler Apr. 1966 18 p refs
(Contract AT(45-1)-1830)
(BNWL-202) CFSTI: HC $1.00/MF $0.50

Tensile specimens of Hastelloy X-280, a solution-hardenable nickel-base alloy, were given various experimental preirradiation thermal and/or mechanical treatments. They

were subsequently irradiated at 540°F to exposures of approximately 1×10^{20} nvt ($E \geq 1$ Mev) and then tensile tested at room temperature and 1350°F in air. When compared with a standard commercial treatment, the experimental treatment generally showed reduced radiation damage. Some treatments increased postirradiation high temperature ductility by 100% while maintaining strength. One treatment resulted in 100% increase in postirradiation high temperature yield strength with only 2 to 4% ductility loss. Also, a maximum increase of 57% in postirradiation room temperature yield strength was possible while maintaining 18% uniform elongation. Possible mechanisms for the property improvement are set forth; these are based on the character of the interaction of the microstructures, formed by the preirradiation treatments, with neutron irradiation. Author (NSA)

N66-32353# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.

EFFECTS OF FAST ELECTRON IRRADIATION, FABRICATION HISTORY, AND WATER OXYGEN ON THE ENVIRONMENTAL BEHAVIOR OF ZIRCONIUM ALLOYS

W. A. Burns Aug. 1965 87 p refs

(Contract AT(45-1)-1830)

(BNWL-88) CFSTI: HC $3.00/MF $0.75

The corrosion program included the Zr alloys: Zircaloy-2, Zircaloy-4, Ni-free Zircaloy-2, and Zr–3 wt % Nb–1 wt % Sn. In addition to the fast neutron irradiations, the effects of heat treatment, preirradiation, coolant irradiation alone, anisotropy of texture, heavy cold work, and hydrogen addition to the water environment on the corrosion of the Zr alloys were measured. Exposure data were obtained on over 350 specimens and included time to 264 days, neutron flux intensities from 2×10^{12} to 1×10^{14} nv (>1 Mev), integrated fast neutron exposure to 1.9×10^{21} nvt, and variations in water oxygen content from ~1 ppM to <0.1 ppM. The following tentative conclusions were drawn from the experimental results. Oxygen content of the water environment has a marked influence on in-reactor corrosion rates. Corrosion rates are significantly higher in high-oxygen water than in low-oxygen water. Posttransition oxidation rates in-reactor in high-oxygen water correspond with pretransition rates in low-oxygen water. The fast-neutron component of reactor radiation is primarily responsible for the acceleration of corrosion. Oxidation rates are more sensitive to fast flux magnitude in the thin-film region. Acceleration effects of fast flux on oxidation are more pronounced above 10^{13} nv, and a practical threshold level near 10^{11} is probable. Oxygen–hydrogen content of the water environment influences in-reactor sorption of corrosion hydrogen. Hydrogen pickup fractions are higher in low-oxygen water than in high-oxygen water. Hydrogen pickup fraction is not influenced by changes in the fast flux above the threshold for oxidation effects. Hydrogen pickup fraction is influenced by film thickness. It increases with increasing film thickness in high-oxygen water. It decreases with increasing film thickness in low-oxygen water. Heat treatment and texture effects are important variables in in-reactor corrosion behavior. For any of the alloys tested there is no indisputable evidence for direct pickup of hydrogen from the water environment. At low magnification, the physical appearance of the surface and cross sections of oxide films formed in-reactor are similar to those of films formed in the absence of radiation. Electron microscopy has disclosed a markedly higher population of microcracks in cross sections of in-reactor formed oxide as compared with unirradiated oxide. NSA

N66-32430*# Chicago Univ., Ill. Dept. of Physics.

THE STRUCTURE OF DI-VALENT AND TRIAVALENT METALS

V. Heine and D. Weaire [1966] 48 p refs

(Grant NsG-352)

(NASA-CR-76750) CFSTI: HC $2.00/MF $0.50 CSCL 11F

The structures of the di- and trivalent metals Be to Hg and Al to Tl are considered from a fundamental point of view, based on the pseudopotential and second order perturbation theory. The most significant factors for the structure of a simple metal are the valence, and the position q_0 of the first zero of the pseudopotential. The q_0 in turn can be related to atomic properties such as the radius of the ion core and the sp promotion energy. When q_0 falls near a set of reciprocal lattice vectors, distortions from a simple structure are likely to occur. The variation of q_0 through the periodic table gives a qualitative explanation of the variation of c/a ratio from Be to Cd, the occurrence of distorted structures in Hg, Ga, and In, and the behavior of the InPb and InSn solid solution alloys, as well as features of the molten metals and some other elements. Author

N66-32433*# AVCO Corp., Tulsa, Okla.

SURFACE BLISTERING OF METALS BY ION BOMBARDMENT Final Report, Mar. 1964–Apr. 1965

Aug. 1965 30 p refs Prepared jointly with Okla. Univ. Res. Inst.

(Contract NASw-920)

(NASA-CR-76757; TR-65-352-F) CFSTI: HC $2.00/MF $0.50 CSCL 11F

Ingots of 99.999 percent pure aluminum were irradiated with mass analyzed proton and hydrogen ion beams. The irradiated materials were subsequently annealed at various temperatures for different durations and observed by photomicrography. Variation of proton energy and sample purity showed predictable results; however, the effects of sample temperature, proton flux, and oxide layer thickness have yet to be determined. The size of blisters and degree of segregation appears to be related to sample purity and degree of cold work. Additional studies involving aluminum and gold are underway. Author

N66-32461# California Univ., Livermore. Lawrence Radiation Lab.

PHYSICAL AND MECHANICAL PROPERTIES OF U–7.5 w/o Nb–2.5 w/o Zr ALLOY

C. A. W. Petersen and W. E. Elkington 17 Feb. 1966 12 p

(Contract W-7405-ENG-48)

(UCRL-14724) CFSTI: HC $1.00/MF $0.50

The physical and mechanical properties of a uranium–7.5 wt/% Nb–2.5 wt/% Zr alloy aged in the temperature range 150–350°C are reported. The mechanical strength of the alloy increased with aging temperature and time within this range. More reproducible mechanical properties were obtained from the heat treatments than previously reported. The tensile yield strength was typically 92,000 psi after a 1-hr, 150°C heat treatment; 215,000 psi after 4-hr, 350°C heat treatment. Elongations for these strength levels were 20 and 3.5%, respectively. Electron-diffraction data show that an ordered structure was developed during aging at 150°C for 10^4 minutes. It is believed that the increase in strength, which results at this aging temperature is partly due to this ordering of the alloy. Author (NSA)

N66-32470# McGill Univ., Montreal (Quebec). Mechanical Engineering Research Labs.

RESPONSE OF METALS TO HIGH STRAIN RATES—A REVIEW OF THE LITERATURE

G. Kardos May 1964 32 p refs
(Rept.-64-1, Rev.)

Strain rate data are extracted from current literature as part of a research program on the effect of heat treatment on high strain rate properties of steel, for use in design of gun launched vehicles. The dislocation theory of metal deformation is presented to explain molecular processes reponsible for metallic failure. Failure is attributed to the mechanisms of twinning, dislocation movement and generation, and crack nucleation and propagation. Predictions are made about the response of metals to technically high strain rates based on metal physics examination and test results. S.P.

N66-32472# Rocky Flats Div., Dow Chemical Co., Golden, Colo.

A DENSITY STUDY OF BERYLLIUM

V. R. Friebel and G. A. Campbell 21 Jan. 1966 7 p refs
(Contract AT(29-1)-1106)
(REP-679) CFSTI: HC $1.00/MF $0.50

Densities were determined for beryllium in the vacuum-cast and wrought vacuum-cast conditions produced as part of the beryllium development program. The average densities of the Rocky Flats as-cast and wrought beryllium were approximately the same as that of commercial powder-pressed beryllium but varied over a smaller range. The density was more uniform in Rocky Flats as-cast ingots and wrought sheets than in commercial powder-pressed material.

Author (NSA)

N66-32481# Oak Ridge National Lab., Tenn.

RADIATION METALLURGY SECTION, SOLID STATE DIVISION Progress Report, Period Ending Feb. 1966

May 1966 49 p refs
(Contract W-7405-ENG-26)
(ORNL-3949) CFSTI: HC $3.00/MF $0.50

Unirradiated simulated weld heat-affected-zone samples of ASTM A-212B pressure-vessel steel corresponding to a heat input of 100,000 J/in. exhibited a ductile-brittle transition temperature at 20 ft-lbs of 60°C, which is about 80°C higher than for the base plate. Despite the higher initial ductile–brittle transition temperature, the heat-affected-zone samples for 100,000 J/in. heat input underwent an increase in ductile–brittle transition temperature of about the same magnitude as for the base plate (an increase of about 90°C after irradiation to 9×10^{18} n/cm^2, E > 1 Mev, at 70°C). Another series of heat-affected-zone samples, corresponding to 50,000 J/in., exhibited similar properties to those of the base plate before and after irradiation. Both series of heat-affected-zone samples showed poorer response to post-irradiation recovery anneals. Irradiation of ASTM A-212B steel at 235°C to about 10^{19} n/cm^2 (E>1 Mev) produced about a 75% increase in yield stress, whereas approximately the same dose at 292°C caused an increase of only about 50%. Upon postirradiation annealing, the 292°C-irradiated samples recovered at somewhat higher temperatures and more gradually than the 235°C-irradiated samples. The dose rate effect was investigated for radiation hardening in vacuum-melted iron. For values corrected to a constant dose of 4.6×10^{18} n/cm^2 (E > 1 Mev) at 94°C and test temperature of 30°C, a three-fold increase in yield stress was observed, but over a dose-rate range from 4 to 300×10^{11} n/cm^2 (E > 1 Mev) there was only a slight tendency for greater hardening at the lower dose rates. Whether this apparent trend is real or not will be more easily decided when samples from a still lower dose-rate irradiation are tested. Results are also described for tensile tests as a function of grain size, strain rate, and postirradiation annealing. For a two-hour annealing time, the temperature for 50% recovery is about 350°C and the annealing activation energy is about 3 ev. In the investigation of dislocation dynamics in iron by stress relaxation techniques, an internal or threshold stress is determined that must be exceeded for macroscopic dislocation motion. It is found that radiation hardening in iron is governed mostly by the increase in this stress rather than a change in the stress dependence of the dislocation velocity. The stress relaxation measurements also yield a curve for the activation volume for plastic deformation as a function of effective shear stress. This curve was found to be the same for irradiated and unirradiated samples. The study of plastic deformation in single crystal niobium was continued. An electron-beam floating-zone refiner was installed and the analysis of the purity of the niobium single crystal produced in the refiner begun. A particularly striking and promising development is the success in achieving anomalous X-ray transmission or Borrmann topographs for the single crystals of niobium. These photographs enable one to see dislocations in stereo view in relatively thick samples and are an indication that the dislocation densities are quite low (less than 10^5 dislocations/cm^2). The low dislocation density is borne out by direct counting of dislocation etch pits. The etch-pitting technique was used to measure the dislocation velocity as a function of applied stress. Slip line observations were made on polished surfaces of irradiated and unirradiated niobium. They clearly show the tendency for inhomogeneous slip and the clustering of slip lines into coarse bands in irradiated samples. Stress relaxation measurements were also carried out on the single crystal niobium tensile samples. NSA

N66-32514# Rensselaer Polytechnic Inst., Troy, N. Y. Corrosion Research Lab.

PREDICTING THE INTERGRANULAR CORROSION OF AUSTENITIC STAINLESS STEELS

W. D. France, Jr. and N. D. Greene Oct. 1965 29 p refs
Presented at 21st NACE Conf., St. Louis, 15–19 Mar. 1965
(Contract Nonr-591-17)
(TR-3; AD-624017) CFSTI: HC $2.00/MF $0.50

The precise environmental conditions necessary for the intergranular corrosion of austenitic stainless steels have been determined by potentiostatic methods. Intergranular corrosion of sensitized 18Cr–8Ni stainless steel only occurs in limited potential regions. These results have been used to develop a new method for rapidly predicting the intergranular corrosion tendencies of various sulfuric acid environments. It is also shown that sensitized stainless steels may be used in many media without the occurrence of intergranular attack.

Author (TAB)

N66-32536# Douglas Aircraft Co., Inc., Santa Monica, Calif. Metals-Ceramics Branch.

THE DETERMINATION OF RETAINED AUSTENITE IN TEXTURED MARAGING STEELS

F. T. Wimmer, R. B. Rosenberg, and D. H. Kilpatrick 3 Jul. 1966 38 p refs
(Rept.-48417)

The problem of the quantitative determination of the amount of retained austenite present in textured maraging steels is explored. Several industrial techniques for the determination of retained austenite are reviewed. A technique which was used to evaluate these methods is presented. The

evaluation technique shows that these methods are inadequate for the determination of retained austenite in textured maraging steels. A new system, the pole figure integration technique (PFIT), is presented and evaluated. This method is capable of making a quantitative determination of the amount of retained austenite in textured martensitic steels. Data are presented displaying its capability; these are also compared to optical observations on the same samples. The technique, as presented, is for use in the austenite–martensite system but it can be applied in other metallic and non-metallic systems. Problems associated with the use of PFIT technique are discussed, and some guide lines for its application are presented. Author

N66-32570*# Washington Univ., Seattle.
STRUCTURE AND VISCOSITY OF MOLTEN BORATES AND PHOSPHATES
Anthony Wayne Thompson (M.S. Thesis) 1965 66 p refs (Grant NsG-484)
(NASA-CR-76985) CFSTI: HC $2.50/MF $0.75 CSCL 11F

Experimental viscosity results, as a function of composition, are compared with a theory of ionic activity of silicate slags. Construction and operation of a high-temperature viscometer and resistance furnace suitable for corrosive oxide melts is described, as well as measurement of the viscosity of some liquid borates and phosphates. Viscosity measurements are presented for the binary systems of sodium and lead borate, and sodium, lead, potassium, and calcium phosphate. Efforts were made to verify the assumption that pure single-phase liquids measured exhibit Newtonian behavior. With respect to physical behavior, the glasses measured were clear and appeared homogeneous on cooling; no devitrification was encountered. All melts to which vacuum was applied showed evidence of outgassing to varying degrees.
S.P.

N66-32591# Joint Publications Research Service, Washington, D. C.
PIPE PRODUCTION
26 Jul. 1966 38 p refs Transl. into ENGLISH from Proizvodstvo Trub (Moscow), issue 15, 1965 p 62–66; 80–89; 95–100
(JPRS-36679; TT-66-33110) CFSTI: $1.00

CONTENTS:

1. DISTRIBUTION OF NONMETALLIC INCLUSIONS AND GASES IN CENTRIFUGALLY CAST HOLLOW PIPE BILLETS WITH LARGE DIAMETER MADE OF STEELS Kh18N10T AND Kh18N12T N. V. Ruilla, G. D. Samoylov, V. F. Mal'tsev, E. N. Pashchenko, and V. Y. Sych p 1–8 refs
2. MECHANICAL PROPERTIES AND STRUCTURE OF PIPES FROM ALLOYS EP150, EP151 AND EI869 AS A FUNCTION OF THEIR HEAT TREATMENT CONDITIONS N. S. Alferova, A. V. Lagosha, O. Ya. Khodor, and T. Ya. Vasil'yeva p 9–14
3. STRUCTURAL CHANGES IN CENTRIFUGALLY CAST PIPE BILLETS MADE OF STEEL Kh18N10T DURING HOMOGENIZATION AND THE EFFECT OF THESE CHANGES ON THEIR DUCTILITY IN THE HOT STATE N. S. Alferova and N. S. Pishchik p 15–22 refs
4. ASPECTS OF ALKALI–ACID TREATMENT OF CERTAIN STEELS N. V. Bogoyavlenskaya, N. G. Parkhomenko, and I. S. Stefanskiy p 23–31 refs

N66-32593# Washington Univ., Seattle.
PREDICTION OF TERNARY THERMODYNAMIC PROPERTIES AND PHASE DIAGRAMS USING BINARY DATA
Norman James Olsen (M.S. Thesis) 15 Sep. 1965 75 p refs

Two equations based on the regular solution model are used to predict ternary free energy using binary data. One equation is path dependent, the other is path independent. Both equations yield good results, but the path independent equation holds more promise for predicting phase diagrams. It was found that the path independent equation was applicable to systems where a single phase was formed in the ternary not normally shown on any of the binary systems. The path dependent equation had a tendency to predict a three phase region instead of a single phase in such a system. Applicability of the equations was determined by comparing experimental results obtained with liquid and solid ternary systems. Programs for calculations on an IBM 7094 digital computer are included. K.W.

N66-32616*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COLD REDUCTION AS A MEANS OF REDUCING EMBRITTLEMENT OF A COBALT-BASE ALLOY (L-605)
Gary D. Sandrock and L. Leonard (Case Inst. of Technol.) Washington, NASA, Aug. 1966 28 p refs
(NASA-TN-D-3528) CFSTI: HC $2.00/MF $0.50 CSCL 11F

The effect of prior cold reduction (up to 40 percent by rolling) on the room-temperature tensile ductility of L-605 (HS-25) after aging at 1600°F for times up to 1000 hours was determined. Prior cold work was found to lessen the embrittling effect of 1600°F exposure and cause increased room-temperature tensile strength and hardness, which were largely maintained even after long (1000 hr) aging times. The nature of the precipitation was changed from that of a preferential intergranular type, as observed in unworked L-605 after aging, to a much more homogeneous type within the grains. This effect was believed to be the primary reason for improved postaging ductility. X-ray diffraction studies confirmed the previously reported precipitation of Co_2W and an M_6C type carbide, but showed that prior cold work tended to alter the carbide reaction. Author

N66-32677*# National Research Corp., Cambridge, Mass. Norton Exploratory Research Div.
A STUDY OF THE ADHESION AND COHESION OF METALS
Interim Summary Report, 9 Mar. 1965–9 Mar. 1966
M. J. Hordon and J. R. Roshrig [1966] 43 p
(Contract NASw-1168)
(NASA-CR-76828) CFSTI: HC $2.00/MF $0.50 CSCL 11F

Measurements of the adhesion characteristics of a variety of metals were conducted in high vacuum. The contact surfaces were cleaned prior to loading by argon or xenon ion bombardment or by wire brush abrasion. The applied loads exceeded the nominal yield stress. Although the ion bombardment produced substantial changes in the surface electron work function as determined by the retarded field diode technique, the resultant adhesion values were generally negligible. Smooth, flat surfaces of copper showed greater bonding than roughened surfaces. Using the abrasion method, the adhesion of both soluble and insoluble metal pairs was studied. The results showed that lattice solid solubility was less important than surface cleanliness and ductility in governing the extent of interfacial welding. Under optimum conditions, bond efficiencies up to 90% were obtained for extremely ductile metals. Author

18 MATERIALS, NONMETALLIC

Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For basic research see: 06 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellants; and 32 Structural Mechanics.

N66-31506# Army Medical Biomechanical Research Lab., Walter Reed Army Medical Center, Washington, D. C.
GLASS TRANSITION TEMPERATURES OF POLY ALKYL ALPHA CYANOACRYLATES
Harold J. Porter and R. K. Kulkarni Feb. 1966 13 p refs
(TR-6602; AD-633041) CFSTI: HC $1.00/MF $0.50

The glass transition temperatures of a series of poly alkyl alpha cyanoacrylates were determined by the technique of dilatometry, using mercury as confining liquid to note the volume changes. Author (TAB)

N66-31508# Marine Corps Landing Force Development Center, Quantico, Va.
HELICOPTER LANDING SITE MATERIALS
18 May 1966 26 p refs
(AD-632958) CFSTI: HC $2.00/MF $0.50

Tests were conducted to determine the suitability of a flexible vinyl-nylon membrane as a helicopter landing site material. Two different weights of material and two different configurations were tested. One configuration was 150' square. The other consisted of four (4) 75' square sections joined in the field to provide a 150' square pad. The test results have shown that the single piece, 150' vinyl-nylon helipad provides a distinct advantage in minimizing dust and mud problems at advanced base helicopter landing sites where more permanent surfacing materials are unavailable or impractical for this purpose. The membrane serves only as an expedient measure over unprepared sand such as experienced in Vietnam. It is recommended that this item be approved for Marine Corps use as an interim measure until a more universal material is developed. Author (TAB)

N66-31579# Joint Publications Research Service, Washington, D. C.
DETERMINING PARTICLE MAGNITUDE IN SYNTHETIC LATEX BY ELECTRON MICROSCOPY
S. E. Selivanovskiy, Yu. M. Yakovlev, A. V. Lebedev, and N. A. Fermor *In its* Electron Microscopy and Met. Studies 23 Jun. 1966 p 47-52 refs (See N66-31575 18-26) CFSTI: $3.00

In order to prevent deformation and coalescence of latex globules, methods are used such as bromination, γ-irradation and potassium-sulfate vulcanization. Using bromination, particle dimensions are determined for certain latexes manufactured industrially. Author

N66-31623*# General Electric Co., Philadelphia, Pa.
STUDIES OF MECHANICS OF FILAMENTARY COMPOSITES Annual Report, Sep. 27, 1964-Sep. 26, 1965
Norris F. Dow, B. Walter Rosen, and Zvi Hashin Washington, NASA, Jun. 1966 228 p refs
(Contract NASw-1144)
(NASA-CR-492) CFSTI: HC $6.00/MF $1.25 CSCL 11D

Studies are reported relating to the enhancement of understanding of the roles played by both binders and reinforcements in the attainment of advanced properties with fibrous composites. Previous analyses of properties and of efficiency of application are reviewed and extended. New analyses are developed for viscoelastic behavior and for three-dimensional reinforcement. Results of mechanical and photoelastic evaluations of transverse effectiveness of filamentary reinforcement are presented. Author

N66-31655# Aerospace Research Labs., Wright-Patterson AFB, Ohio. Metallurgy and Ceramics Research Lab.
THE DETERMINATION OF THE STRUCTURE OF BORON IN "AMORPHOUS" BORON FILAMENTS
Harry A. Lipsitt *In* Office of Aerospace Res. Proc. of the OAR Res. Appl. Conf. [1966] p 141-150 refs (See N66-31646 18-34) CFSTI: HC $5.00/MF $0.50

An X-ray and electron microscopic study of boron filaments has shown that the boron is not "amorphous" as suggested by others. We have shown the boron to be a layered crystalline structure with extensive faulting in the layer stacking. The influence of structure on boron filament potential is discussed. Author

N66-31918# Royal Aircraft Establishment, Farnborough (England).
FILLER REINFORCEMENT IN SILICONE POLYMERS. PART I: THE EFFECT OF FINELY DIVIDED MATERIALS ON LIQUID POLYMERS
D. K. Thomas and B. B. Moore Feb. 1966 26 p refs
(RAE-TR-66061) CFSTI: HC $2.00/MF $0.50

The effect of finely divided materials on a polydimethyl silicone oil has been studied in the temperature range from 30° to 130°C using a variable shear viscometer. The results are consistent with the view that fine powders become solvated on being dispersed in the oil; if a sufficient number of particles are present per unit volume of mixture and if the interactions between them are sufficiently large, aggregation can occur to give a micro-gel structure. Those materials which are highly reinforcing in silicone elastomers show evidence of micro-gel structure at volume concentrations below 4%. For fillers of a given chemical type there are indications that the viscosity increment is dependent solely on mean particle size: there are further indications that carbon black is more effective in raising the viscosity than silica providing they are of comparable particle sizes. Author

N66-31945# Atomic Energy of Canada, Ltd., Chalk River (Ontario).
ON THE EFFECT OF TiO_2 ADDITIONS ON DEFECT STRUCTURE, SINTERING AND GAS RELEASE OF UO_2
Hj. Matzke May 1966 39 p refs
(AECL-2585) CFSTI: HC $2.00/MF $0.50

Small additions of TiO_2 are known to increase the density of sintered UO_2. It is shown that this effect coincides with an increase in the diffusion rate of the slower moving ion, the uranium ion. Quantitative metallography and measurement of the gas release following high-dose ion-bombardment show that small amounts of titanium are soluble in UO_2. Possible mechanisms by which TiO_2 affects the disorder of UO_2 are discussed. Reduction of TiO_2 and interstitial solution of the small titanium ions are favoured. Similar experiments are reported for $ThO_2 + TiO_2$. A simple model for the disorder in UO_2 is given and the gas release data are discussed. Author

N66-32069*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ENVIRONMENTAL TENSILE TESTING OF NYLON PARACHUTE MATERIALS

Joseph A. Farkas *In its* Publ. of Goddard Space ... ht Center, 1963, Vol. II [1963] p 684-692 ref (See N66-32044 18-31) CFSTI: HC $7.00/MF $5.00

Tensile tests have been performed to investigate the possible degradation in strength of textile parachute components at −190°C after sterilization by exposure to 135°C in air or nitrogen, and to an ethylene oxide gas mixture of 12 percent concentration by weight. Materials utilized in the parachute canopy, suspension, and reinforcing were selected for consideration. All were composed of nylon, except one of the experimental fiber, HT1. After each phase of sterilization, specimens were tested at room temperature and at −190°C. Break load and strain measurements indicated that heating in air produced various degrees of degradation to the load limit while heating in nitrogen and exposure to ethylene oxide had no apparent effect. The immediate cold temperature environment appeared to effect only the strain, which was severely restricted. Author

N66-32097# Army Natick Labs., Mass. Pioneering Research Div.

THERMAL CONDUCTIVITY OF POLYSTYRENE: SELECTED VALUES

Lois C. K. Carwile and Harold J. Hoge Apr. 1966 21 p refs (TR-66-27-PR; AD-632712) CFSTI: HC $1.00/MF $0.50

The published literature on the thermal conductivity of polystyrene was assembled and the results critically evaluated. Best values of thermal conductivity as a function of temperature were selected. These are presented in both graphical and tabular form; the tables cover the range 240°K to 540°K and a few of the plotted points lie outside this range. An attempt was made to consult all work that could significantly affect the choice of best values. Published papers were located with the aid of Chemical Abstracts, Physics Abstracts, the Thermophysical Properties Retrieval Guide, and some other general sources. In addition, relevant references in the papers themselves were followed up until a substantially closed system was generated, as shown by the fact that no new references were being turned up. Author (TAB)

N66-32154# Forest Products Lab., Madison, Wis.

FATIGUE CHARACTERISTICS OF TWO NEW PLASTIC LAMINATES, REINFORCED WITH UNWOVEN "S" GLASS FIBERS, UNDER CYCLIC AXIAL OR SHEAR LOADING Technical Report, Jan.-Sep. 1965

Kenneth H. Boller Wright-Patterson AFB, Ohio, AF Mater. Lab., Mar. 1966 37 p refs (Contract AF 33(615)-5002) (AFML-TR-66-54; AD-630884)

The report presents the fatigue characteristics of plastic laminates made of two new resin systems reinforced with unwoven S glass fibers. This knowledge adds to the data that have already been generated to evaluate the fatigue properties of typical laminates. The results show that by incorporating stronger resins to bind the fiber bundles the axial fatigue life of a laminate is increased. For example: the number of the median life cycles at 54,000 pounds per square inch for crossply constructions was increased from 3,000 to 53,400, and a 40,000 pounds per square inch it was increased from 17,850 to 659,250 when shear strengths of the resin systems were changed small aounts rom 8,800 to 9,320 pounds per square inch or 4,740 to 4,880 pounds per square inch, depending on method of test. Another example: the number of median life cycles at 75,000 pounds per square inch for a plus or minus 5 degrees construction was increased from 7,500 to 18,500 cycles when shear strength only changed from 10,620 to 11,120 pounds per square inch. Author (TAB)

N66-32196# Naval Air Engineering Center, Philadelphia, Pa. Aeronautical Materials Lab.

AN EVALUATION OF THE EFFECT OF THE THICKNESS OF WASH PRIMER

R. S. Adler 21 Jan. 1966 15 p ref (NAEC-AML-2343; AD-632248) CFSTI: HC $1.00/MF $0.50

Adhesion characteristics of the specifications MILC-22750A (WEP) epoxy-polyamide and the MIL-C-19537 (Aer) acrylic-nitrocellulose systems using thick and thin coatings of MIL-C-8514 (Aer) wash primer are compared over various metal surfaces. The adhesion of both finish systems utilizing the heavier .6 ±.1 mils wash primer is significantly better in dry adhesion tests and as good, or better, in wet adhesion tests than the .2-.3 mils wash primed systems. Corrosion resistance of 2024 bare aluminum alloy panels with no chemical treatment, and coated with the aforementioned systems is better when thick .6 ±.1 mil MIL-C-8514 (Aer) wash primer is applied as compared to the thin .2-.3 mil wash primer. Recommendation is made to use the thicker coat of wash primer and to incorporate the necessary changes in the applicable process specifications. Author (TAB)

N66-32289*# Case Inst. of Tech., Cleveland, Ohio. Polymer Science Group.

MORPHOLOGICAL STUDIES OF POLYETHYLENE TEREPHTHALATE, PART III Status Report, Oct. 31, 1965-Apr. 30, 1966

P. H. Geil and Gregory Yeh [1966] 39 p refs (Grant NGR-36-003-054) (NASA-CR-76738) CFSTI: HC $2.00/MF $0.50 CSCL 11I

The morphology of polyethylene terephthalate has been studied by electron microscopy. The morphology of the glassy state is characterized by ball-like structures. Crystallizations from the glass occurs in spherulites similar to those obtained from the melt. Although the long period increases as measured by small angle X-ray scattering with annealing temperature, it decreases with time at a given annealing temperature. Strain induced crystallization occurs by alignment of the ball-like structures. Subsequent heat setting of the strained material produces more complete alignment of the ball-like structures. A special technique, low-angle electron scattering, has been developed in order to investigate the details of the morphology of polyethylene terephthalate. Author

N66-32290*# Case Inst. of Tech., Cleveland, Ohio. Polymer Science Group.

INFRARED STUDIES OF THE ORIENTATION PROCESS IN POLYETHYLENE TEREPHTHALATE, PART II Status Report, Oct. 31, 1965-Apr. 30, 1966

J. L. Koenig and Steve Cornell [1966] 35 p refs (Grant NGR-36-003-054) (NASA-CR-76737) CFSTI: HC $2.00/MF $0.50 CSCL 11I

The strain induced crystallinity of stretched polyethylene terephthalate is not temperature dependent below the glass transition temperature, but above it, several crystallization mechanisms are apparently causing temperature dependence. Sequential biaxial stretching of polyethylene terephthalate films induces more trans content and destroys more gauche content than does simultaneous stretching. The former induces a slight orientation in the transverse direction; the latter produces no orientation. Neither process is molecular weight or draw rate dependent. Cyclic mechanical and thermal treatments show that annealing drawn samples further increases

trans content and produces chain folding. Redrawing destroys folding, but increases trans content. Reannealing reproduces folding without increasing trans structure. Author

N66-32492# Naval Ordnance Lab., White Oak, Md. Physics Research Dept.
SOME THERMODYNAMIC PROPERTIES OF CASTOR OIL VS TEMPERATURE AND PRESSURE
John M. Stallard 14 Apr. 1966 22 p refs
(NOLTR-66-68; AD-633263) CFSTI: HC $1.00/MF $0.50

Specific volume, isothermal compressibility, and thermal expansion of Baker db-grade castor oil have been computed from an empirical equation fitted to data obtained by the differential transformer densitometer technique. Data is presented over a temperature range of 0–40°C and a pressure range of 1–1000 bars. Author (TAB)

N66-32682*# Martin Co., Baltimore, Md.
DEVELOPMENT TEST REPORT FOR SATURN V HYDRODYNAMIC SUPPORT
R. Frost Nov. 1965 56 p
(NASA-CR-76911; ER-14037) CFSTI: HC $2.50/MF $0.50 CSCL 11H

Procedures and results of seven different tests are given. They are: (1) an air-to-oil interface test to determine the foaming characteristics resulting from sudden air degassing of the hydraulic oil; (2) flow control development tests conducted on four valves; (3) performance of four hydraulic pressure regulators in reducing pressure from 2900 psi to 2700 psi; (4) performance of capillary valves in a hydraulic system in flow–opening and flow–pressure drop tests; (5) determination of the changes in oil level in the air spring of a float height indicating system; (6) test of the electrical resistance of a bearing contact warning system; and (7) utilization of the thermistor as a function of immersion or nonimmersion to produce a workable float sunk warning system. Illustrations and diagrams are included. K.W.

19 MATHEMATICS

Includes calculation methods and theory; and numerical analysis. For applications see: 08 Computers.

N66-31718# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires.
DETERMINATION OF A BASIC SET OF EIGENFUNCTIONS AND OF THE CORRESPONDING NORM IN THE CASE OF THE ONE-VELOCITY INTEGRAL DIFFERENTIAL BOLTZMANN EQUATION IN SPHERICAL GEOMETRY [DETERMINATION D'UNE BASE DE FONCTIONS PROPRES ET DE LA NORME CORRESPONDANTE DANS LE CAS DE L'EQUATION INTEGRODIFFERENTIELLE DE BOLTZMANN A UNE VITESSE ET EN GEOMETRIE SPHERIQUE]
Pierre Lafore Dec. 1965 60 p refs In FRENCH
(CEA-R-2926)

A basic set of orthogonal eigenfunctions is derived for resolving the one-velocity integral-differential Boltzmann equations for spherical configurations. NSA

N66-31768*# Bellcomm, Inc., Washington, D. C.
THE ANALYSIS OF A COUNTDOWN AS A STOCHASTIC SEQUENTIAL PROCESS WITH RECYCLE POLICIES
J. S. Engel 16 Aug. 1965 37 p ref
(Contract NASw-417)
(NASA-CR-76438; TM-65-1031-2) CFSTI: HC $2.00/MF $0.50 CSCL 12A

The countdown is a large program which consists of the logical combination of several activities, with various recycle policies in the event of failures. Each activity is a stochastic process, in that the time required for its performance may be a random variable. In addition, the occurrence of equipment failures constitutes a random process. The entire countdown is thus a stochastic process and the total time required to complete it is a random variable. The probability density function for the total countdown duration is derived in terms of the distributions of the basic random variables for each activity. The model which is analyzed is quite general and is descriptive of many programs which consist of the combination of several individual activities. The analysis procedures are applicable to many other similar problems. Author

N66-31777# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
THE CAUCHY INTEGRAL OF TEMPERED DISTRIBUTIONS AND SOME THEOREMS ON ANALYTIC CONTINUATION
E. J. Beltrami and M. R. Wohlers Jul. 1966 27 p refs To be presented at the 1966 Fall Meeting of Soc. of Ind. and Appl. Math., N. Y. State Univ., Stony Brook, 12–15 Sep. 1966
(RM-333J)

A continuation formula for holomorphic functions that map a half plane into itself and, in particular, for positive real functions was established. This continuation formula is extended to a larger class of holomorphic functions. The approach is in terms of the Cauchy integral of tempered distributions, which are defined. Results concerning such Cauchy integrals are summarized since they are of independent interest, and the explicit boundary behavior of such Cauchy integrals and their derivatives is displayed. The main argument used requires that all calculations with tempered distributions be reduced to a more restricted class of objects by means of a suitable division. Crucial to the proof of the continuation theorem is a representation for positive real functions. The use of the Cauchy integral for distributions to factor holomorphic functions in a strip is also discussed. Author

N66-31802# California Univ., Livermore. Lawrence Radiation Lab.
EVALUATION OF FEYNMAN'S FUNCTIONAL INTEGRALS
Robert L. Zimmerman 11 Sep. 1964 29 p refs
(Contract W-7405-ENG-48)
(UCRL-12049-T) CFSTI: HC $2.00/MF $0.50

Several relations for Feynman's functional integrals are derived. From these relations two different schemes are constructed for approximating Feynman's functional integral. The methods of approximation are expected to converge sufficiently rapid in many cases so that only the lowest orders of the approximation are required to give reliable answers. Author (TAB)

N66-31981# Wisconsin Univ., Madison. Dept. of Statistics.
MODELS FOR PREDICTION AND CONTROL. I: AIMS AND MEANS
G. E. P. Box and G. M. Jenkins (Lancaster Univ.) May 1966 16 p ref
(Contract NSF GP-2755)
(TR-72)

The selection and use of mathematical models for forecasting and control are considered. The necessity for accurately forecasting and controlling industrial processes is explained, and the model applications are discussed. Various types of mathematical models are described including empirical, mechanistic, dynamic, and stochastic. Some basic ideas in model building are presented and it is pointed out that the smallest possible number of constants for adequate representation should be employed. Guidelines for selecting the correct models for the purposes at hand are also reported. A.G.O.

N66-32090# Research Analysis Corp., McLean, Va.
STATISTICAL DECISION ANALYSIS OF STOCHASTIC LINEAR PROGRAMMING PROBLEMS
Jerome Bracken and Richard M. Soland Feb. 1966 28 p refs
(Contract DA-44-188-ARO-1)
(RAC-TP-199; AD-633427) CFSTI: HC $2.00/MF $0.50

This paper presents a statistical decision analysis of a one-stage linear programming problem with deterministic constraints and stochastic criterion function. Procedures for obtaining numerical results are given that are applicable to any problem having this general form. After stating the statistical decision problems to be considered, the expected value of perfect information and the expected value of sample information are discussed. In obtaining these quantities, use is made of the distribution of the optimal value of the linear programming problem with stochastic criterion function; therefore Monte Carlo and numerical integration procedures for estimating the mean of this distribution are discussed. The case in which the random criterion vector has a multivariate normal distribution is presented separately, and more detailed methods are offered. Author (TAB)

N66-32091# Maryland Univ., College Park.
STABLE MOTIONS OF THE LINEAR ADIABATIC OSCILLATOR
Robert B. Kelman and Niel K. Madsen Mar. 1966 19 p refs
(Contract Nonr-595(17))
(BN-436; AD-632707) CFSTI: HC $1.00/MF $0.50

This paper studies the real solutions of the differential equation $y''+(1+f+H\cos 2nx)y=0$ where f(x) is an absolutely integrable function, h(x) is a function of bounded variation and n is a positive constant. By a solution of the equation is meant a function which has an absolutely continuous first derivative and which satisfies the equation almost everywhere. TAB

N66-32133*# Rutgers Univ., New Brunswick, N. J. Statistics Center.
TWO-STAGE CHAIN SAMPLING INSPECTION PLANS WITH DIFFERENT SAMPLE SIZES IN THE TWO STAGES
K. S. Stephens and H. F. Dodge Apr. 1966 45 p refs Supported in part by NASA
(Contract Nonr-404(18))
(NASA-CR-76626; N-23; AD-632236) CFSTI: HC $2.00/MF $0.50 CSCL 12B

This report presents a further generalization of the family of 'two-stage' chain sampling inspection plans—the use of different sample sizes in the two stages. Plans presented in previous reports specify the use of the same sample size in both stages. Evaluation of the operating characteristics is accomplished by the Markov chain approach developed in the preceding reports. Markov chains for a number of plans are included and several algebraic solutions are developed. Since these plans involve a variable amount of sampling, an evaluation of the average sample number (ASN) is developed. OC curves are presented and discussed for plans with acceptance numbers, C_1, C_2=0,1; 0,2, 1,2; and 0,3, 1,3 and sample sizes, N_1, N_2=10,5; 20,10; and 200,100. ASN curves for the same plans for N_1, N_2=200,100 are also presented. Then to compare the two-sample-size plans with plans having only one sample size, OC curves for a number of each of these types of plans are presented. Comparisons indicate that improved discrimination is achieved by the two-sample-size plans. Author (TAB)

N66-32139*# Alabama Univ., University.
TOPOLOGICAL DYNAMICS Quarterly Progress Report, Jan.–Mar. 1966
[1966] 6 p
(Contract NAS8-1646)
(NASA-CR-76564) CFSTI: HC $1.00/MF $0.50 CSCL 12A

Topological analyses were made of one-dimensional dynamic systems with potentials periodic in time, and of the oblateness of a body motion about a Newtonian geoid. The topological approach yielded a parallel development of the Floquent analysis of Hill's lunar theory and the general properties of Mathieu functions. The oblateness found in the second problem is briefly described by the second Legendre polynomial, in accordance with the major perturbation of a close-in earth satellite. R.Ll.

N66-32163# Stanford Univ., Calif. Dept. of Statistics.
THE DIVISION OF SPACE BY HYPERPLANES WITH APPLICATIONS TO GEOMETRICAL PROBABILITY
Thomas Cover and Bradley Efron 10 Aug. 1965 18 p refs
(Contract Nonr-225(52))
(TR-108; AD-620278) CFSTI: HC $1.00/MF $0.50

Invariant combinatorial properties are investigated of convex cones and their dual cones generated by collections of vectors in a Euclidean space. These properties, which include the number of non-degenerate cones, the number of k-faces of these cones, and the natural measures of the set of k-faces, do not depend on the configuration of the set of generating vectors, except for a weak non-degeneracy requirement. Applications to geometrical probability are given. Author (TAB)

N66-32207# California Inst. of Tech., Pasadena.
SOLUTION OF LINEAR EQUATIONS WITH DIGITAL COMPUTERS
C. W. Mc Cormick and K. J. Hebert Sep. 1965 77 p ref

Details are given of a digital computer program for handling extremely large band matrixes for the analysis of large distributed elastic systems. The program is written in two parts; the first part is for symmetrical matrixes of such size that the complete problem can be stored in core memory; the second part assumes that the problem is too large for core memory and that at least one disk channel is available. Routines, which are included, are written for an IBM 7094, but they can also be assembled for the IBM 7090 if seven index registers are available. Methods of solution and computing time are discussed at length. K.W.

N66-32215# Electronic Systems Div., Bedford, Mass. Technical Requirements and Standards Office.
VERIFICATION OF QUANTITATIVE MAINTAINABILITY REQUIREMENTS

Giacomo Grippo and Richard M. De Milia May 1965 86 p refs
(ESD-TR-65-220; AD-465416) CFSTI: HC $8.60/MF $0.75

This document develops basic concepts for treating Maintainability quantitatively, with particular attention devoted to probabilistic aspects. It focuses on the special characteristics of the Lognormal Distribution as they relate to specifying and demonstrating numerical requirements. A catalog of Lognormal curves (both density and cumulative distribution functions) are included as well as recommended accept–reject criteria for Maintainability demonstration. Author (TAB)

N66-32217# Texas A&M Univ., College Station.
OPERATIONAL FACTORIZATION OF THE LINEAR SECOND-ORDER DIFFERENTIAL EQUATION WITH VARIABLE COEFFICIENTS
Larry Morton Austin (M. S. Thesis) May 1966 55 p refs
(Contract AF 33(608)-1284)
(AD-481449)

The mathematical concepts embodied in this thesis are not new. The transformation which reduces a second-order, linear differential equation with variable coefficients to a Riccati equation has been known for over 200 years. Operational factorization of the general linear differential equation is discussed on a theoretical basis in a number of well-known mathematical texts. The two concepts are fuzed here into a practical, easily understandable solution technique. TAB

N66-32261*# Kent State Univ., Ohio. Dept. of Mathematics.
SAMPLE QUADRATIC VARIATION OF SAMPLE CONTINUOUS SECOND ORDER MARTINGALES Technical Report No. 12
Donald L. Fisk Jul. 1966 20 p refs Submitted for Publication
(Grant NsG-568)
(NASA-CR-76705) CFSTI: HC $1.00/MF $0.50 CSCL 12A

Consideration is given to the problem of determining when the limit of the sequence of a stochastic process exists in probability, and to finding this limit when it exists. The process is assumed to be a continuous sampled second order martingale, and the probability and in some cases the mean limits are obtained. C.T.C.

N66-32295*# Brown Univ., Providence, R. I.
PERIODIC SOLUTIONS OF A CLASS OF HYPERBOLIC EQUATIONS CONTAINING A SMALL PARAMETER
Jack K. Hale [1966] 46 p refs
(Grants NGR-40-002-015; NSF GP-4362; DA-31-124-ARO(D)-270)
(NASA-CR-76728) CFSTI: HC $2.00/MF $0.50 CSCL 12A

The purpose of the present paper is to discuss a method for the determination of solutions u(t,x) and v(y,z) of the problems

$$u_{tt} - u_{xx} = \epsilon\, g(t,x,u,u_t,u_x),$$

$$u(t,0) = u(t,\pi) = 0,$$

and

$$v_{yz} = \epsilon\, f(y,z,v,v_y,v_z),$$

respectively, with $u(t+2\pi,x) = u(t,x)$, $v(y+2\pi,z) = v(y,z) = v(y,z+2\pi)$ provided that g is 2π-periodic in t and f is 2π-periodic in y,z and ϵ is a small real parameter. Our aim in this paper is to show that the method used by L. Cesari and the author for similar problems in ordinary diffential equations can be extended in a completely analogous way to these equations. Author

N66-32332*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
INVERSE OF THE VANDERMONDE MATRIX WITH APPLICATIONS
L. Richard Turner Washington, NASA, Aug. 1966 16 p refs
(NASA-TN-D-3547) CFSTI: HC $1.00/MF $0.50 CSCL 12A

The inverse of the Vandermonde matrix is given in the form of the product $U^{-1}L^{-1}$ of two triangular matrices by the display of generating formulas from which the elements of U^{-1} and L^{-1} may be directly computed. From these, it is directly possible to generate special formulas for the approximation of linear transforms such as integrals, interpolants, and derivates for a variety of functions that behave as P(x)f(x), where P(x) is a polynomial and f(x) is generally not a polynomial and may have localized singularities. Author

N66-32348# Argonne National Lab., Ill.
RSSR ROUTINE, A ROOT-SQUARING AND SUBRESULTANT PROCEDURE FOR FINDING ZEROS OF REAL POLYNOMIALS
Edwin H. Bareiss and Ronald Hamelink (Michigan State Univ.) Oct. 1965 73 p refs
(Contract W-31-109-ENG-38)
(ANL-6987) CFSTI: HC $3.00/MF $0.75

The theoretical background of the RSSR Routine, a program for finding simultaneously all roots of a real polynomial equation is described. Codes for the IBM-704 and CDC-3600 are described, including complete listings of FORTRAN statements. These codes are designed to solve polynomials of degree up to order 20 to 30, but dimensioning allows the possible solution of polynomial equations of degree up to 50. A set of sample problems is presented which may also serve to test other root-finding routines. Author (NSA)

N66-32445# California Univ., Berkeley. Dept. of Mathematics.
THE PONTRYAGIN MAXIMUM PRINCIPLE
Stephen P. Diliberto Mar. 1966 32 p
(Contract Nonr-222(88))
(AD-481532)

The paper has a derivation of the full maximum principle of Pontryagin. The paper proves the bang-bang principle for non-linear systems and for non-convex control regions. Author (TAB)

N66-32510# Stanford Univ., Calif. Dept. of Statistics.
A WAITING TIME DISTRIBUTION ARISING FROM THE COUPON COLLECTOR'S PROBLEM
Herman Rubin and James Zidek 5 Aug. 1965 10 p ref
(Contract Nonr-225(52))
(TR-107; AD-620290) CFSTI: HC $1.00/MF $0.50

This report is concerned with a certain waiting time distribution which arises from the Coupon Collector's Problem. In general, "Coupon Collector's Problem" refers to the problem which confronts an individual who is attempting to collect a subset of some set of distinct items by sampling with replacement and equal probabilities, one item from this set on each of a sequence of independent trials until this subset is obtained. The number of trials so required is the waiting time, S, in question. In the first portion of this report, the exact distribution of S is determined. In the second, an approximation to this distribution is derived in the case where the subset is the set itself. Calculations illustrating the effectiveness of this approximation are given. Author

N66-32562# France. Ministere de l'Air, Paris.
GENERAL PARAMETERIZATION OF A LINEAR PROGRAM [PARAMETRISATION GENERALE D'UN PROGRAMME LINEAIRE]
Henri Maurin Serv. de Doc. Sci. et Tech. de l'Armement, 1966 104 p refs In FRENCH
(NT-149) CFSTI: HC $3.00/MF $0.75

A method is presented for determining optimal solutions of a linear program whose second member and several bounding matrix vectors are linearly dependent on a single parameter. Four simple numerical examples are solved. This method also allows for the solution of nonlinear programs which contain the product of some variables by several other variables in the same linear form. Finally, the method is applied to a nonlinear program relating to the preparation of volatile carbons in a petroleum refinery.
Transl. by J.G.

N66-32633*# Wisconsin Univ., Madison. Mathematics Research Center.
OPTIMAL CONTROL AND CONVEX PROGRAMMING
J. B. Rosen Feb. 1965 28 p refs
(Grant NsG-565; Contract DA-11-022-ORD-2059)
(NASA-CR-76959; MRC-547; AD-614939) CFSTI: HC $2.00/MF $0.50 CSCL 12A

A general type of discrete optimal control problem with both control and state constraints is considered. Necessary conditions for a relative minimum are given (assuming only differentiability) based on the Kuhn–Tucker theory. For a convex function and linear system of differential equations it is shown that these conditions are also sufficient for a global minimum. A computational scheme is described for the state constrained problem where the conditions are sufficient. The scheme is based on a convex programming method and determines first if any admissible control exists, and if so, finds an optimal control. The solution of a four-dimensional system with state constraints is presented in order to illustrate this computational scheme. Author

N66-32658# Gt. Brit. Ministry of Aviation, London. Technical Information and Library Services.
MONOTONIC RANGE OF SOME NON-LINEAR DIFFERENTIAL EQUATIONS [OB OBLASTI MONOTONNOSTI NEKOTORYKH NELINEIIYKH DIFFERENTSIAL'NYKH URAVNENII]
Z. M. Lushnikova Jul. 1966 13 p refs Transl. into ENGLISH from Ural'skogo Politekhn. (Sverdlovsk, USSR), 1958 p 46–52
(TIL/T-5405) CFSTI: HC $1.00/MF $0.50

The paper examines systems of differential equations equivalent to the non-linear equations: $x+ax+f(x)=0$, $x+\phi(x)+bx=0$, $x+\phi(x)x+bx=0$, $x+ax+bx+f(x)=0$ and formed by substituting $x=y$ and so on. Any solution of such a system is considered as being monotonic relative to the function $V=(x/2)$, if the time derivative dV/dt for the solution in question is negative. The open zone G containing the monotonic trajectories of the system relative to V, is called the zone of monotony. The object is to assess the zone of monotony of the above systems of differential equations.
Author

20 METEOROLOGY

Includes climatology; weather forecasting; and visibility studies. For related information see also: 13 Geophysics; and 30 Space Sciences.

N66-31840# National Aerospace Lab., Tokyo (Japan).
METEOROLOGICAL CONDITIONS ON AIRCRAFT ICING. I
Masazi Koseki, Kiiti Tadera, Hideo Izumi, Mikio Ota, and Masakatu Minegisi 1966 35 p refs In JAPANESE; ENGLISH summary
(NAL-TR-101) CFSTI: HC $2.00/MF $0.50

Data from flight measurements of the meteorological factors related to aircraft icing are presented. The data are divided according to two broad clouds types, cumuliform and stratiform clouds. They are presented in such a manner as to give the frequency of occurrence of observed icing conditions according to two of the meteorological variables, namely liquid water contents versus mean effective droplet diameters, liquid water contents versus pressure altitude, and mean effective droplet diameters versus pressure altitude.
Author

N66-31863# Weather Bureau, Washington, D. C.
ON THE PROBABILITY FORECASTING OF THE OCCURRENCE OF PRECIPITATION
Lawrence A. Hughes Nov. 1965 44 p refs *Its* Tech. Note No. 20-CR-3
(TN-20-CR-3; PB-169246) CFSTI: $2.00

Discussed are definitions, verification graphs, and the Brier score without and with climatology considered. Two methods of computation of the Brier score with climatology included are discussed. In the Chicago result, the reliability was high with an average deviation of only 2.1 percent in the first 12-hr forecast period and 4.8 percent in the fourth period. The resolution was moderate in the first period and dropped rapidly thereafter. Skill dropped almost to 0 for periods beyond about 36 hr from forecast time. Seasonal variations were minor but were underplayed by the forecasters. When the probability numbers were compared with probability words prepared concurrently, a wide range of probability numbers was found in each of the four main word categories selected, suggesting that the meaning of the words is not constant among forecasters. In the "no rain" category the number of forecasts had high reliability, thus showing information not communicated by the forecaster. Probability numbers are thus better than probability words.
Author

N66-31892*# Kaman Aircraft Corp., Colorado Springs, Colo. Nuclear Div.
VARIABILITY OF SOUND PROPAGATION PREDICTION DUE TO ATMOSPHERIC VARIABILITY Final Report
C. Eugene Buell 10 Jun. 1966 198 p
(Contract NAS8-11348)
(NASA-CR-76464; KN-66-698-1(F)) CFSTI: HC $3.25/MF $1.25 CSCL 04B

The effect of varying meteorological parameters on sound intensity estimates at distances from a few to several tens of kilometers is discussed. The meteorological parameters involved are virtual temperature, wind components, and humidity. Sound intensity estimates are based on the results of a ray tracing technique. Variations of intensity estimates as determined by Monte Carlo methods are discussed. Variability is found to be around 5 dB regardless of whether the magnitude of atmospheric variability corresponds to that expected over a fraction of an hour or to half a day. A significant factor is determining the probability of returning sound rays at a given location. Basic characteristics of wind, temperature, and vapor pressure variability are discussed. The effect of atmospheric variability on sound attenuation is different than that due to the effect on the geometry of the propagative pattern and may be determined by standard methods. Results indicate that

atmospheric humidity variability is the most important factor. Small scale perturbations have little effect, while large scale perturbations that enter into variations expected over a period of half a day may account for intensity variability of near 5 dB at 10 km. R.N.A.

N66-31905*# Travelers Research Center, Inc., Hartford, Conn.

THE PREDICTABILITY OF WIND AND VIRTUAL TEMPERATURE PROFILES FOR FLIGHT AND STATIC TEST OPERATIONS Final Report, Jul. 1, 1965–Mar. 31, 1966

Keith W. Veigas, David B. Spiegler, John T. Ball, and Joseph P. Gerrity, Jr. Mar. 1966 109 p refs *Its* Rept.-7473-209 (Contract NAS8-20234)

(NASA-CR-76536) CFSTI: HC $3.00/MF $0.75 CSCL 04B

The predictability of wind and virtual temperature profiles from the surface to 30 km for 0- to 72-hr forecast intervals has been evaluated. Meaningful forecast verification criteria were established for each of four NASA operational problem areas affected by winds and virtual temperatures: (a) launch and flight of an aero-space vehicle, (b) propagation of sound from missile firings (both static and real), (c) diffusion of toxic fields, and (d) design of missiles. Predictions of wind and virtual temperature profiles prepared by various methods were evaluated by the criteria established for the four problem areas. It was concluded that the state of the art was deficient in several areas of profile predictions considering the user's requirements. A technique development plan was designed to guide the development of new prediction techniques and to tailor existing techniques specifically to meet the National Aeronautics Space Administration/Marshall Space Flight Center operational requirements. Author

N66-31906# Weather Bureau, Salt Lake City, Utah.

THE VALUE OF WEATHER FORECASTS

Halbert E. Root Washington, Environ. Sci. Services Admin., Dec. 1965 14 p refs Presented at the Natl. Meeting of the Am. Meteorol. Soc., Riverside, Calif., Jun. 1965 *Its* Western Region Note No. 3 (TN-27-WR-3)

This study summarizes the relative value of weather forecasts to the economy considering the variation with the skill of the forecasts, the form in which the forecasts are expressed, and the climatological frequency of the critical weather event to be considered. Five levels of forecast information are studied: none, climatological information, conventional forecasts, probability forecasts, and perfect forecasts. It is shown that: (1) the potential value per unit potential loss of weather forecasts to any given segment of the economy is inversely proportional to the cost-to-loss ratio; (2) the potential value to the economy of weather forecasts over climatological information is inversely proportional to the climatological frequency of the critical weather event considered; (3) the range of the economy over which conventional forecasts are superior to climatological information is a function of the skill of the forecasts, with the greatest benefits realized by those segments of the economy with cost-to-loss ratios near the climatological frequency of the critical weather event considered; (4) the value of reliable probability forecasts is equal to or better than the value of conventional forecasts for all segments of the economy. Author

N66-31971# Weather Bureau Research Station, Fort Huachuca, Ariz.

FORECASTING DAYTIME TEMPERATURES UTILIZING AVAILABLE SOLAR ENERGY

Huron A. Marmon Washington, Environ. Sci. Services Admin., Dec. 1965 24 p refs *Its* Western Region Note No. 4 (TN-28-WR-4; PB-169385) CFSTI: $1.00

A simplified technique is presented for the forecasting of temperatures from sunrise to the occurrence of a maximum temperature. The technique is expedited by the use of graphs and an equal area mean method to replace computations of the pressure–temperature factor and the trial and error method formerly used. The initial technique is developed for a dry desert region (Las Vegas, Nev.) and a clear sky. A simple method for applying the technique to other locations and sky conditions is then developed. This is done by substituting local constants in the calculations for the sky cover albedo value, seasonal constant, and ground parameter value. The time required to plot the temperature sounding to the required height, surface pressure less 240 mb., and to forecast one or more daytime temperatures is normally less than 5 min. The tests using independent data, for Las Vegas and Fort Huachuca, totaled 1250 forecasts of which 88% were within 3°F. The results using dependent data indicate the data are not restricted to clear dry conditions if local prevailing values are used in the calculations. E.A.O.

N66-31978# Bureau of Reclamation, Denver, Colo. Electric Power Branch.

WEATHER AND LOAD PATTERN CORRELATION STUDY TO DEVELOP A METHOD OF SHORT-RANGE LOAD FORECASTING BASED ON WEATHER AND LOAD DATA

R. R. Fillenberg and J. S. Tronvold 13 Nov. 1965 32 p refs (PB-169380)

Weather patterns and electric power system load characteristics were investigated with a digital computer for linear correlation. Total system and 3 small local area loads and weather data from 7 stations of the Region 6, Eastern Division, Missouri River Basin power system were studied. Daily load characteristics investigated were minimum load, noon peak, evening peak and average load; with average load showing best correlation. Weather elements of temperature, wind velocity, cloud cover and precipitation versus load were machine tested in single and multiple correlations. Conclusions were: (1) Loads of small areas show a higher degree of correlation with weather than do large area loads where diversity in load and weather degrade correlation. (2) Correlations were found between average daily load versus average daily temperature, wind velocity, and cloud cover in descending order of significance. Correlations between load and precipitation were insignificant. Load patterns of an area conform to weather on a daily and seasonal basis. (3) A formula was developed for use in short range, 1 to 30 days, forecasting of load which may utilize daily, weekly or monthly weather predictions, and is based on factoring a computed small local area typical load in each of 3 major areas with essentially uniform weather. The 3 major areas together comprise the total system area. Author

N66-32033*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

PERCENTAGE CLOUD COVER FROM TIROS PHOTOGRAPHS

Albert Arking *In its* Publ. of Goddard Space Flight Center, 1963, Vol. I [1963] p 1313–1319 refs (See N66-32006 18-30) GPO: HC $9.75; CFSTI: MF $7.50

The analysis of approximately 1500 Tiros pictures, on a digital computer, has yielded statistical data on the global distribution of cloud cover from 12 July to 30 September 1961, between 60°S and 60°N. The latitudinal distribution of

percentage cloud cover for that period is compared with a fifty-year mean based upon ground observations; the broad features of the two distributions are in agreement. Author

N66-32205# Pennsylvania State Univ., University Park. Mineral Industries Experiment Station.

SYNOPTIC APPLICATIONS OF INFRARED SATELLITE DATA Interim Report, 1 Jan.–31 Oct. 1965

Robert Bradford, Clifford Frasch, Chin-Hua Huang, Mae D. Lethbridge, Hans A. Panofsky et al 31 Oct. 1965 41 p ref (Grant WBG-48)

(PB-169238) CFSTI: $2.00

It is shown that DV, a quantity derived from surface ocean temperature and window radiation, is a fair indicator of vertical velocity and vorticity advection over the Atlantic, north of latitude 35°. The correlation is worse over the Pacific, probably due to poor vertical velocity observations there. Cross spectrum analysis indicates that the correlation is mostly produced by wave lengths of order 40° longitude, and the three fields are essentially in phase, but 90° out-of-phase with the height field. Precipitation probability is strongly related to DV. In particular, the probability of precipitation exceeding .04" in the 12 hours following an orbit varies from 2% for low DV to 66% for high DV. Water-vapor radiation (6–6.5 μ) appears to contain some additional information, the statistical significance of which needs further examination. Further, window radiation alone appears to be at least as good an indicator as DV. Water-vapor radiation has a strong diurnal variation, with largest amounts of vapor in the upper troposphere indicated in the daytime. Author

N66-32308# RAND Corp., Santa Monica, Calif.

SOVIET DATA ON THE ARCTIC HEAT BUDGET AND ITS CLIMATIC INFLUENCE

J. O. Fletcher, B. Keller, and S. M. Olenicoff, ed. May 1966 201 p refs

(Contract AF 49(638)-1700; Proj. RAND)

(RM-5003-PR; AD-632995) CFSTI: HC $6.00/MF $1.25

A collection of papers bearing on the heat budget of the arctic and its interrelationship with world climate. Most are heretofore unavailable translations from the Russian. Also included are an introduction to the collection as a whole by the senior editor, and a summary of what is known and what may be suspected of the relationship between the arctic heat budget and atmospheric circulation at lower altitudes. Author (TAB)

N66-32333*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

FOCAL POINT COMPUTATION IN A THREE-LAYERED ATMOSPHERE

James E. Mabry 24 Jun. 1966 40 p refs

(NASA-TM-X-53479) CFSTI: HC $2.00/MF $0.50 CSCL 04B

This report outlines a computer program for calculating, directly from the atmospheric data, the location of ground level acoustic foci resulting from meteorological conditions in a three-layered atmosphere. Also, a procedure is given whereby one obtains the average intensity level in the immediate neighborhood of a focus. Finally, it is shown, by means of examples, that a systematic use of the computer program can lead to a deepened insight into the relationship of the focus location and the atmospheric parameters. Author

N66-32444# Canada. Dept. of Transport, Toronto. Meteorological Branch.

LONG TERM TRENDS IN VANCOUVER'S WEATHER

J. B. Wright 4 Feb. 1966 16 p refs

(CIR-4375; TEC-596) CFSTI: HC $1.00/MF $0.50

The abnormal summer of 1964 in Vancouver followed by a record breaking December prompted a closer look at comparative weather data to determine if the climate is changing. Graphs of mean summer and winter hours of bright sunshine, mean temperature, and total precipitation show a noticeable departure from normal during the period 1945 to 1964. Author

N66-32499# Air Force Dept., Washington, D. C.

CLEAR AIR TURBULENCE MEETING, 19–20 AUGUST 1964

[1964] 81 p

(AD-632827) CFSTI: HC $3.00/MF $0.75

The purpose of meeting is (a) To have a free and complete exchange of information among all agencies involved in research and study in the forecasting and detection of clear air turbulence. (b) To review current and planned programs to determine if there is sufficient effort in each area. (c) To determine areas where efforts should be better coordinated and/or consolidated. There is not at this time a fully proven indicator of CAT. Most of the efforts described are directed at determining if a given parameter can provide such indication. TAB

N66-32539# Oklahoma Univ. Research Inst., Norman. Atmospheric Research Lab.

INVESTIGATION OF TYPHOON AND HURRICANE TRAJECTORIES Annual Report, 1 Jul. 1964–30 Jun. 1965

Yoshikazu Sasaki 30 Jun. 1965 13 p refs

(Grant NSF GF-172)

Research was conducted on selected cases of mature hurricanes, with availability of sufficient data as the selection criterion. Distribution of temperature, pressure, moisture, clouds, wind, momentum, and heat transport were analyzed. The effects of surface frictional layers and of thermal structure on energy and motion of the hurricane was determined. Cold air effects, vorticity, and divergence distribution were computed. Mathematical models were developed for hurricanes and typhoons with asymmetric structure. Studies were centered on the hurricanes Dora and Cleo of 1964. K.W.

N66-32553*# Chicago Univ., Ill. Dept. of the Geophysical Sciences.

ANGULAR DEPENDENCE OF ALBEDO FROM STRATIFORM CLOUDS AS MEASURED BY TIROS IV SCANNING RADIOMETERS

Asmund Rabbe Jun. 1966 27 p refs

(Grant NsG-333)

(NASA-CR-76799; SMRP-58) CFSTI: HC $2.00/MF $0.50 CSCL 04B

Pictures and radiation data from two orbits of Tiros IV have been used in this study to show the anisotropy in the albedo of low stratiform clouds. In order to scan the same clouds from two different directions we have used the radiation data when the satellite was in an alternating mode while the floor and wall sensors scanned the earth successively. To express the anisotropy we have used the specular angle, ω, and the backscattering angle, ψ_0, as parameters. The results show that the albedo is dependent on these two parameters, particularly the specular angle. Author

N66-32581# Department of Transport, Ottawa (Ontario). Meteorological Branch.
VERTICAL WIND SHEAR IN THE BOUNDARY LAYER
R. B. Pettitt and R. G. Root 9 Dec. 1965 39 p refs
(CIR-4345; TEC-590) CFSTI: HC $2.00/MF $0.50

Vertical wind shear in the lowest 200 feet of the planetary boundary layer is examined at two Canadian sites: Montreal (an urban installation) and Whiteshell, Manitoba (situated in open, very flat country). Shear magnitudes are examined, various maximum observed shears are tabulated, and the data are related to the power law. Seasonal and directional variations of wind shear are correlated well with wind speed, terrain and cover-type; inversion and non-inversion cases are also considered separately and the dependence of shear on lapse rate, thus, determined. The maximum scalar shear at Whiteshell was 28 mph/180 ft; at Montreal it was 19 mph/165 ft. Author

N66-32589# Weather Bureau, Washington, D. C.
WIND SPEEDS FROM TIROS PICTURES OF STORMS IN THE TROPICS
A. Timchalk, L. F. Hubert, and S. Fritz Feb. 1965 43 p refs
(Rept.-33)

An empirical technique is developed by which the maximum wind speeds in hurricanes can be estimated from satellite picture data. Two parameters are derived from pictures: a size measurement and a ranking of the degree of spiral band organization. The picture data are plotted versus the maximum wind speeds derived, in most cases, from airplane reconnaissance of 1962 typhoons in order to develop the technique. Similar data from the 1963 hurricane season are used for testing the method. Preliminary results indicate the estimated speeds may be accurate to about ±20 kt. The rules developed for assessing the picture data are discussed and illustrated. The results at this stage indicate that some of the subjectivity may be removed by measuring the angles between the spiral bands and concentric circles and by defining a simpler size parameter. Speculatively, the reason for the empirical results could involve the vertical motion field of storms that is associated with the angular momentum budget, and the development of critical values of shear and stability. Author

21 NAVIGATION

Includes guidance; autopilots; star and planet tracking; inertial platforms; and air traffic control. For related information see also: 07 Communications.

N66-32057*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A LINEARIZED ANALYSIS AND DESIGN OF AN AUTOMATIC BALANCING SYSTEM FOR THE THREE-AXIS AIR BEARING TABLE
Felix Zajac and David Small *In its* Publ. of Goddard Space Flight Center, 1963, Vol. II [1963] p 379-388 (See N66-32044 18-31) CFSTI: HC $7.00/MF $5.00

Analysis and design of an automatic control system to reduce the mass inbalance torques for a three-axis air bearing table to 5000 dyne-cms or less, are presented. This system senses a positional error from the initial position and corrects the inbalance by driving a weight along the appropriate axis. In the roll and yaw axis position, the table is rotated through 20° when the pitch balancing mode is initiated and the movement of the pitch weight brings the center of gravity to coincide with the center of rotation. In the pitch balancing mode, an additional position sensor is used together with yaw balancing controls to limit table movement relative to the axis. The table has to be returned to the first position and the balancing procedure then repeated for the roll and yaw axes. Analog computer evaluation found both balancing systems stable with a balancing time of 2 minutes sufficient for each position; this established the total time for fine balancing as approximately 10 minutes. G.G.

N66-32291*# Tennessee Univ., Knoxville. Dept. of Electrical Engineering.
METHODS FOR INJECTION ERROR ANALYSIS AND THEIR COMPARISON Scientific Report No. 13
J. D. Irwin and J. C. Hung 1 Aug. 1966 33 p refs
(Grant NsG-351)
(NASA-CR-76734) CFSTI: HC $2.00/MF $0.50 CSCL 17G

Statistical techniques for the analysis of missile injection errors are studied in detail. The commonly used direct and adjoint methods are reviewed and extended. It is shown that the determination of the covariance matrix is equivalent to the determination of two transformation matrices for both methods. In general, the adjoint method is more efficient. But for a special case the direct method could be preferable depending upon the relative dimension of the system state and the error source. Two samples are given to verify the results. The techniques presented can equally well be applied to a wide variety of control system problems. Author

N66-32402# Joint Publications Research Service, Washington, D. C.
NAVIGATIONAL AIDS IN SOVIET CIVIL AVIATION
12 Jul. 1966 6 p Transl. into ENGLISH from Grazhdanskaya Aviatsiya (Moscow), no. 3, Mar. 1966 p 22-23
(JPRS-36440; TT-66-32872) CFSTI: $1.00

This article briefly describes the operation and characteristics of the navigational aids employed by the U.S.S.R. in their civil aviation. They include the airborne Doppler navigation system, the integrated VHF omnidirectional range (VOR) and instrument landing system equipment, the combined VOR-distance measuring equipment system, and airborne radar. R.N.A.

N66-32551*# Army Map Service, Washington, D. C.
GEMINI CELESTIAL DISPLAY DEVICE STUDY
1 Mar. 1965 100 p
(NASA-CR-65006) CFSTI: HC $2.50/MF $0.75 CSCL 17G

This report presents the finalized design of a celestial navigation device for use with the Gemini spacecraft. The display device is a visual comparator which provides an out-of-the-window star field observable during a manned orbital mission to the Gemini flight crew. By a visual comparison of the actual out-of-the-window view to its similar representation on the device, an astronaut can determine the location of the orbiting Gemini spacecraft relative to the stars. Concise summaries of all engineering computations used in the design are given. Results are tabulated in specific data. The device is described and its basic design principles are defined. Applications of these principles to support the planning and fabrication of the device are specified. R.N.A.

22 NUCLEAR ENGINEERING

Includes nuclear reactors and nuclear heat sources used for propulsion and auxiliary power. For basic research see: 24 Physics, Atomic, Molecular, and Nuclear. For related information see also: 03 Auxiliary Systems; and 28 Propulsion Systems.

N66-31509# American Inst. of Aeronautics and Astronautics, New York. Div. of Technical Information.
AIAA SPECIALISTS CONFERENCE ON RANKINE SPACE POWER SYSTEMS, VOLUME I
Washington, AEC [1965] 729 p refs Conf. held at NASA Lewis Res. Center, Cleveland, 26–28 Oct. 1965
(CONF-651026, Vol. I) CFSTI: HC $8.00/MF $4.00

Conference papers on Rankine cycle power systems, reactors and shields, liquid metal pumps, boilers, turboalternators, radiators, and condensers are presented. For individual titles see N66-31510–N66-31535.

N66-31510# Atomics International, Canoga Park, Calif.
MERCURY RANKINE PROGRAM DEVELOPMENT STATUS AND MULTIPLE SYSTEM APPLICATION
R. L. Wallerstedt and D. B. Miller *In* AIAA AIAA Specialists Conf. on Rankine Space Power Systems, Vol. I [1965] p 3–51 refs (See N66-31509 18-22) CFSTI: HC $8.00/MF $4.00

Considerable test experience (over 2300 hours) has been accumulated at Atomics International in the area of complete Mercury Rankine systems. This testing included a space-configured system operating in a vacuum chamber, a structural mockup system for vibration testing, and a system designed to simulate the effects of zero gravity condensing. Each of these system tests has contributed significantly toward a better understanding of the operation of a Mercury Rankine system and the combination of systems has demonstrated the feasibility of ground startup, launch survival, simulated orbital startup, and simulated steady-state operation in space. In this paper the basic objectives and overall accomplishments of these systems are discussed, the experience gained in test operations is presented, and the significant test results are summarized and discussed. Author

N66-31511# Atomics International, Canoga Park, Calif. Space Systems Dept.
MERCURY RANKINE PROGRAM SYSTEM TEST EXPERIENCE
P. M. Gresho, F. W. Poucher, and F. C. Wimberly *In* AIAA AIAA Specialists Conf. on Rankine Space Power Systems, Vol. I [1965] p 52–102 refs (See N66-31509 18-22) CFSTI: HC $8.00/MF $4.00

The Mercury Rankine (MR) space power conversion concept has arrived at the threshold of utilization as a working spacecraft subsystem. Component and system feasibility has been verified and the program is now in a reliability improvement phase. The rotating machinery and other prime components have demonstrated greater than 3000 hr life with a relatively high degree of reliability. Development emphasis has now been shifted to verifying the expected life to 10,000 hr. System characteristics such as design point performance, startup, thermal interactions, structural responses, etc. have been analyzed and verified in a comprehensive system test program. System design for applications has developed the multiple power conversion conept to increase the electrical output and reliability from 3 to 40 kwe. Multiple 3 to 5 kwe power conversion subsystems are combined to provide any power level or degree of redundancy in that range. Potential missions have been studied and the resulting criteria introduced into the requirements as applicable to a general development program. Author

N66-31512# Aerojet-General Corp., Azusa, Calif. SNAP-8 Div.
SNAP-8 DEVELOPMENT STATUS—SEPTEMBER 1965
R. Gordon and H. O. Slone (NASA, Lewis Res. Center) *In* AIAA AIAA Specialists Conf. on Rankine Space Power Systems, Vol. I [1965] p 103–138 refs (See N66-31509 18-22) CFSTI: HC $8.00/MF $4.00
(Contract NAS5-411)

The status of the development of the SNAP-8 Program is summarized. The actual weights and measured performance of subsystems and components are listed. The development problems are described and the total amount of operating time and operating experience for each component is listed. The rated power loop (RPL-2) has operated for over 800 hours; and the PCS-1 (power conversion system 1), phase I test operations, have been completed. Results from these are included. Author

N66-31513# Sandia Corp., Albuquerque, N. Mex.
AEROSPACE NUCLEAR SAFETY
V. E. Blake, Jr. *In* AIAA AIAA Specialists Conf. on Rankine Space Power Systems, Vol. I [1965] p 141–152 (See N66-31509 18-22) CFSTI: HC $8.00/MF $4.00
(Contract AT(29-1)-789)
(SC-DC-65-1752)

This paper gives an overall look at the space nuclear power program, emphasizing the safety problems and approaches. A description is given of the various nuclear systems presently under development. A partial listing of isotope fuels of interest, along with some of their important characteristics, is also provided. Comparisons are drawn between the usefulness of nuclear power, and other forms of space power. A simplified hazard chart is presented showing the many combinations of events that can occur in the use of nuclear power in space. The chart illustrates how a systematic check can be made to assure no hazard path has been overlooked. An example is presented which shows how a significant reduction in calculated hazard was achieved in a nuclear power application by use of this chart and other techniques. A brief study of the hazards caused by meteorites is presented. It is suggested that this natural hazard can provide a basis for assessment of nuclear power for space, although additional work in the area will be required. The paper concludes by challenging industry to take an active interest in the safety of aerospace nuclear power supplies. Author

N66-31514# Oak Ridge National Lab., Tenn.
THE SNAP SHIELDING PROGRAM AT ORNL
C. E. Clifford and J. Lewin *In* AIAA AIAA Specialists Conf. on Rankine Space Power Systems, Vol. I [1965] p 153–189 (See N66-31509 18-22) CFSTI: HC $8.00/MF $4.00
(Contract W-7405-ENG-26)
(ORNL-P-1736; CONF-651026-2)

The space reactor shielding program is concerned with the development of advanced techniques for calculating accurately the intensity of the radiation transmitted through shields designed for both manned and unmanned missions, and also for calculating, by iterative processes, a minimum-

weight design for these shields within the radiation level constraints for a given mission. The development program includes improving and coupling Monte Carlo and multigroup transport codes, as well as performing experimental work to provide a test of the accuracy of the transport codes. Experimenatl results to be obtained include simple geometry neutron scattering experiments, studies of the deep penetration of neutrons in slabs, and an engineering test utilizing a SNAP reactor and shield. A significant portion of the theoretical work is in the design and error evaluation of the more complicated experiments. The complex geometry of shields for space systems and the need for a high level of confidence in the predicted radiation intensities in space systems requires the extension of shielding technology to the rigorous Monte Carlo techniques made possible by the advancement in computer size and speed. Author

N66-31515# Aerojet-General Corp., Azusa, Calif. SNAP-8 Div.

DEVELOPMENT OF A SNAP-8 PUMP FOR MERCURY SERVICE

E. S. Chalpin, J. R. Pope, and C. L. Foss *In* AIAA AIAA Specialists Conf. on Rankine Space Power Systems, Vol. I [1965] p 171–185 refs (See N66-31509 18-22) CFSTI: HC $8.00/MF $4.00

(Contract NAS5-417)

A mercury boiler feed–pump–motor assembly was designed, built, and tested for the SNAP-8, 35-kilowatt mercury Rankine-cycle, nuclear turboelectric space power system. The design incorporates, on a single shaft, a centrifugal pump and an ML-insulated, conventional 400 cps, 3-phase induction motor. The rotor is supported by angular-contact ball bearings of M-50 material. Polyphenyl ether (mix-4P3E) fluid is circulated through the motor housing, space-seal heat exchanger, and bearings for lubrication and cooling. A visco pump and a molecular pump are used in series to minimize the loss of mercury to space. A slinger and a molecular pump in series are used to reduce leakage of mix-4P3E to space and to preclude leakage of the lubricant to the motor cavity during operation. Carbon-face static seals are incorporated to minimize leakage of the process fluids while the assembly was shut down, and to preclude interchange of the fluids. A liftoff device is incorporated to lift the carbon seals from the rotating shaft during operation. A jet-pump is incorporated upstream of the centrifugal pump to provide positive suction head to the centrifugal impeller at very-low-flow start conditions. The pump–motor assembly is all-welded for positive sealing. Author

N66-31516# Aerojet-General Corp., Azusa, Calif. SNAP-8 Div.

DESIGN AND DEVELOPMENT OF PUMPS FOR HIGH-TEMPERATURE NaK SERVICE

E. S. Chalpin, C. P. Colker, and C. L. Foss *In* AIAA AIAA Specialists Conf. on Rankine Space Power Systems, Vol. I [1965] p 186–200 (See N66-31509 18-22) CFSTI: HC $8.00/MF $4.00

(Contract NAS5-417)

The SNAP-8 35-kilowatt nuclear turboelectric space power system uses a sodium–potassium alloy (eutectic NaK-78) to transmit heat to and from the mercury Rankine-cycle loop. Two pump-motor assemblies of like configuration were designed, built, and tested for service in the NaK heat-input loop and in the heat-rejection loop. The units are self-contained, all-welded, and hermetically sealed. They incorporate on a single shaft a centrifugal pump, a hermetically-sealed (canned) drive motor, an internal NaK lubricant-coolant circulating pump, and NaK-lubricated bearings. Included with the pump-motor assembly are a heat exchanger-cold trap combination utilizing a polyphenyl ether fluid as the coolant, a NaK economizer, and a NaK filter. The NaK lubricant-coolant circuit is independent of the process pumping circuit, attained through the use of a shaft-to-housing annulus. No static or dynamic seals are used. The bearings are of the tilting-pad journal and thrust design. Over 1800 hours of testing have established the design performance and integrity of the pump-motor assembly. Basic problems resolved were positive containment of NaK without leakage, operable bearings utilizing NaK as the lubricant-coolant, and a motor which is operable in a space and radiation environment. Plots of H–Q, efficiency, power, and NPSH are presented. A comparison to show correlation of performance data obtained using water and NaK is also presented. Author

N66-31517# General Electric Co., Cincinnati, Ohio.

ELECTROMAGNETIC PUMPS FOR SPACE POWER SYSTEMS

R. G. Rhudy and J. P. Verkamp *In* AIAA AIAA Specialists Conf. on Rankine Space Power Systems, Vol. I [1965] p 201–221 refs (See N66-31509 18-22) CFSTI: HC $8.00/MF $4.00

(Contract NAS3-2543)

This paper constitutes a broad appraisal of the suitability of electromagnetic (EM) pumps for space power application. A general expression for EM pump efficiency is developed in terms of pump design parameters, fluid properties, and frequency of the power utilized. Although approximate, this expression applies to a wide variety of pump types. It is used to indicate parameter ranges promising for the design of pumps of high efficiency. Based on preliminary designs for space power application, performance characteristics and weight of EM pumps of several types are tabulated. The weights of these and other preliminary pump designs for space power application are compared to those of EM pumps which have operated satisfactorily in service. A specific pump design for space power application is described in detail. EM pumps presently operating with high reliability in facility service are discussed. It is concluded that, in EM pumps designed for space power application, it is feasible to achieve pump weights an order of magnitude less than those of contemporary facility pumps for similar hydraulic requirements. Potential reliability is excellent. Author

N66-31518# Atomics International, Canoga Park, Calif.

THE DEVELOPMENT OF THE MRP THERMOELECTRIC NAK PUMP

Harry H. Hanlin, Jack M. Hochman, and Milton A. Perlow *In* AIAA AIAA Specialists Conf. on Rankine Space Power Systems, Vol. I [1965] p 222–257 refs (See N66-31509 18-22) CFSTI: HC $8.00/MF $4.00

A thermoelectromagnetic pump was developed to circulate the heat transfer fluid in a Rankine cycle, space power system. This device combines a dc conduction pump and thermoelectric generator into a single, all-metallic unit. The thermoelectric elements, chromel and constantan, extract heat from the fluid being pumped, convert a portion of it directly into electricity to supply the conduction pump, and reject the waste heat to the secondary working fluid, mercury, as it enters the boiler. This pump type offered the major advantages of no moving parts and complete sealing of the liquid metals for highest reliability and complete utilization of rejected heat for highest system efficiency. The design performance objective of 1 psi, 12 gpm NaK-78 at 1200°F was

achieved and an endurance run to 6000 hours was demonstrated. This report describes the complete development program, detailing the design method and equations, laboratory procedures, and all important test results. Author

N66-31519# Oak Ridge National Lab., Tenn.
EXPERIENCE WITH TURBINE-DRIVEN POTASSIUM BOILER-FEED PUMPS FOR THE MEDIUM POWER REACTOR EXPERIMENT
L. V. Wilson, H. C. Young, and A. M. Smith *In* AIAA AIAA Specialists Conf. on Rankine Space Power Systems, Vol. I [1965] p 258–282 refs (See N66-31509 18-22) CFSTI: HC $8.00/MF $4.00
(Contract W-7405-ENG-26)
(ORNL-P-1740; CONF-651026-4)

A series of potassium vapor turbine driven boilder feed pumps with potassium lubricated bearings has been designed, built and tested for a total of 2000 hr of operation at high temperatures. This paper summarizes the problems that have arisen in the course of the design, fabrication, and operation of these units. Approaches to the thermal expansion problems, provisions for lubricant flow to the bearings, speed pickups, and maintenance of moving parts installed in hermetically sealed systems are discussed. Test experience with the units operated with steam and water is related to the test experience obtained in potassium systems. The problems encountered in fabricating tungsten carbide parts, difficulties both with the brittleness of TZM molybdenum alloy and its tendency to gall and seize, together with solutions that have been found effective for coping with these problems are outlined. Author

N66-31520# Aerojet-General Corp., Azusa, Calif. SNAP-8 Div.
DEVELOPMENT OF THE SNAP-8 BOILER
A. H. Kreeger, J. N. Hodgson, and A. J. Sellers *In* AIAA AIAA Specialists Conf. on Rankine Space Power Systems, Vol. I [1965] p 285–306 refs (See N66-31509 18-22) CFSTI: HC $8.00/MF $4.00
(Contract NAS5-417)

Development of the mercury boiler for the SNAP-8 system is one of the major tasks of the SNAP-8 program. The 1500 hours of testing accumulated on two of the first-generation boilers has permitted detailed evaluation of performance under various operating conditions. Initial tests showed that the boiler performed at only 40% of its thermal design capacity. Even after 600 hours of operation, the boiler could not deliver its rated superheat at design flow rate. Trace amounts of rubidium were added to the mercury. The boiler immediately responded to the additive, reaching its design thermal capacity. A second unit of the same design reached rated thermal output in 26 hours without the use of an additive. This time-dependent conditioning process is the major problem in boiler development. Scaled tests on a single-tube are reported to support a new boiler design which should minimize the conditioning problem. Increased liquid velocity is shown to condition a poorly performing boiler. These scaled tests also provided empirical correlations of heat transfer and pressure drop from which other designs may be extrapolated. Author

N66-31521# Aerojet-General Corp., Azusa, Calif. SNAP-8 Div.
EFFECTS OF OIL CONTAMINATION ON HEAT TRANSFER PERFORMANCE OF FORCED-CONVECTION MERCURY BOILERS
R. S. Carey, B. E. Farwell (Aerojet-Gen. Nucleonics) and G. Thur (NASA, Lewis Res. Center) *In* AIAA AIAA Specialists Conf. on Rankine Space Power Systems, Vol. I [1965] p 307–326 refs (See N66-31509 18-22) CFSTI: HC $8.00/MF $4.00
(Contract NAS5-417)

The major requirements associated with mercury once-through boilers for space powerplants are repeatable startup and reliable long-term heat-transfer performance without deleterious effects on other system components such as turbines, pumps, and condensers. During the past few years, there has been a number of instances where mercury boilers have been known to decondition either during startup or after some period of operation. The connotation is that any performance in the direction of providing poorer heat-transfer performance than expected from either design correlations or some minimum accepted performance is termed deconditioning, while any trend providing improved performance after initial thermal equilibrium is termed conditioning. This performance uncertainty during system startup and endurance operation can prevent adequate startup, cause turbine corrosion/erosion and reduce system power. Author

N66-31522# AiResearch Mfg. Co., Phoenix, Ariz.
MULTIPLE-TUBE POTASSIUM BOILER PERFORMANCE
J. A. Boppart, K. O. Parker, and P. J. Berenson (AiResearch Mfg. Co., Los Angeles, Calif.) *In* AIAA AIAA Specialists Conf. on Rankine Space Power Systems, Vol. I [1965] p 327–356 refs (See N66-31509 18-22) CFSTI: HC $8.00/MF $4.00

Performance testing of a multiple-tube, sodium-heated potassium boiler has been completed as the latest step in a program to develop boilers for potassium Rankine-cycle space power systems. The test boiler contained 19 tubes, with inlet orifices for flow stability and twisted-tape inserts to improve two-phase heat transfer. Test results indicated stable operation over a wide temperature range and at output vapor qualities from 40 percent to 150°F superheat. Performance confirmed predictions at high flows and high exit quality, but was lower than expected at partial flow and low exit quality. This paper describes the design of the test boiler and of the test facility, describes the boiler test, and presents and discusses the test results. Author

N66-31523# General Electric Co., Cincinnati, Ohio. Space Power and Propulsion Section.
HIGH PERFORMANCE "ONCE-THROUGH" BOILING OF POTASSIUM IN SINGLE TUBES
J. R. Peterson *In* AIAA AIAA Specialists Conf. on Rankine Space Power Systems, Vol. I [1965] p 357–388 refs (See N66-31509 18-22) CFSTI: HC $8.00/MF $4.00
(Contract NAS3-2528)

Boiling potassium heat transfer results obtained in a two-fluid Haynes-25 alloy facility are presented. The single-tube test section used is a shell and tube heat exchanger, approximately eight feet long, in which boiling potassium in the tube is heated by sodium flowing in the annulus. Boiler tubes of 0.92-inch and 0.67-inch inside diameter were tested, both with and without instrumented vortex generator inserts. Boiling heat transfer and pressure loss data were obtained from 10% quality to over 200°F of vapor superheat at the test section exit at boiler exit temperatures from 1500 to 1750°F at average heat fluxes up to about 200,000 Btu/hr-ft^2. Author

N66-31524# Sundstrand Aviation—Denver, Denver, Colo.
1.5 KW_e ORGANIC RANKINE CYCLE COMBINED ROTATING UNIT
Donald A. Malohn *In* AIAA AIAA Specialists Conf. on Rankine Space Power Systems, Vol. I [1965] p 391–414 (See N66-31509 18-22) CFSTI: HC $8.00/MF $4.00
(Contracts NOw-62-1037-c; NOw-64-0071-f)

The 1.5 kw organic Rankine cycle combined rotating unit (CRU) consists of a single stage partial admission impulse turbine, main alternator, speed control alternator, and working fluid pump on an integral shaft supported on hydrodynamic tilting pad bearings. An opposing pair of tilting pad thrust bearings are used to control the shaft axial location. The cycle working fluid is used as the bearing lubricant. The working fluid pump is of the pitot type. The organic working fluid used in this Rankine cycle is Dowtherm "A", a utectic mixture of biphenyl and biphenyl oxide. The alternators are of the radial gap homopolar type and produce 3-phase, 3200 cycle power. Power level of the CRU can be varied by changing the size and number of nozzles used. This unit was designed, fabricated, and has been tested in excess of 2,000 hours total cumulative test time. A single set of bearings installed in the CRU has operated in excess of 600 hours, cumulative running time, and has been subjected to in the excess of 100 start-stop cycles. Associated turbine performance testing has indicated good agreement between test results and analytical predictions. Author

N66-31525# TRW, Inc., Cleveland, Ohio.
MRPC (SNAP-2) TURBOALTERNATOR MODEL CRU V
R. C. Biering and O. Decker *In* AIAA AIAA Specialists Conf. on Rankine Space Power Systems, Vol. I [1965] p 415–476 Prepared for Atomics Intern. (See N66-31509 18-22) CFSTI: HC $8.00/MF $4.00
(Contract AT(11-1)-GEN-8)

The Mercury Rankine Power Conversion Program (MRPCP) formerly called SNAP-2 is being conducted to develop the technology required to design a turboalternator for space application. The turboalternator (CRU V) has provided much useful information for this objective, demonstrating to the extent possible the feasibility of a dynamic Mercury Rankine System operating in space. This report presents the CRU V design details and the results of the development program to date. Author

N66-31526# Aerojet-General Corp., Azusa, Calif. Von Karman Center.
DESIGN AND DEVELOPMENT OF A TURBINE-ALTERNATOR ASSEMBLY FOR THE SNAP-8 SYSTEM
M. G. Cherry and G. Oiye *In* AIAA AIAA Specialists Conf. on Rankine Space Power Systems, Vol. I [1965] p 477–497 refs (See N66-31509 18-22) CFSTI: HC $8.00/MF $4.00
(Contract NAS5-417)

The need for a reliable turbine-alternator assembly arose when the potential methods of electrical power generation were considered for the SNAP-8 system. The turbine-alternator for this system was designed to produce 51.6 kw at the alternator terminals at an overall efficiency of 49.5% and to do so reliably and unattended for at least 10,000 hours. Superheated mercury vapor is the working fluid. The turbine-alternator assembly (TAA) consists of two separate but integrated units: the turbine assembly, and the alternator assembly. Polyphenyl ether (mix-4P3E) is supplied to cool the alternator stator and lubricate the bearings. When two fluids such as mercury vapor and polyphenyl ether are in contact with the same shaft, there is a distinct possibility that they will intermix. To prevent this in the SNAP-8 turbine-alternator assembly, a low-leakage seal to space was designed. This seal, situated between the turbine and support bearings, consists of a visco pump, a slinger pump, and a molecular pump in series. The complete turbine alternator assembly has been designed within the "state of the art" to ensure high reliability. Where conflicts of reliability and performance occurred, unless the performance gains were substantial, reliability overruled. Two units have been tested. The first unit was tested using nitrogen gas as the working fluid for the turbine. The purpose of these tests was primarily to check the functional operation of the unit at the design speed, and to obtain measurements of the bearing and slinger losses. The second unit has recently completed some 830 hr of operation at design and off-design conditions in mercury vapor. Author

N66-31527# AiResearch Mfg. Co., Phoenix, Ariz.
POTASSIUM TURBINE-GENERATOR DEVELOPMENT
J. H. Dannan and L. E. Chadbourne *In* AIAA AIAA Specialists Conf. on Rankine Space Power Systems, Vol. I [1965] p 498–520 Sponsored by AF (See N66-31509 18-22) CFSTI: HC $8.00/MF $4.00

A description of the design of a 300-kw high-temperature potassium turbogenerator is given, including representative results obtained from tests of critical turbine and bearing components. Of particular significance are the bearing development tests leading to the selection of hydrodynamic pivoted-pad journal bearings selected for the initial development turbine. The successful development of a high-temperature potassium turbogenerator is expected to provide a technology for the design and construction of high-temperature power plants satisfying special requirements for space and ground applications. Author

N66-31528# General Electric Co., Cincinnati, Ohio. Space Power and Propulsion Section.
PERFORMANCE TEST ON A TWO-STAGE, 200-HORSEPOWER TURBINE IN WET POTASSIUM VAPOR
R. J. Rossbach, E. Schnetzer, H. E. Nichols, and S. E. Eckard *In* AIAA AIAA Specialists Conf. on Rankine Space Power Systems, Vol. I [1965] p 521–546 refs (See N66-31509 18-22) CFSTI: HC $8.00/MF $4.00
(Contract NAS5-1143)

The design, fabrication, and test of a two-stage, 200-horsepower turbine for operation on potassium at inlet vapor temperature up to 1600° F are presented. The two stages represent stages 3 and 4 in a 5-stage, 500-KW turbine for the generation of electrical power during long-time duration space missions. The turbine was fabricated from nickel, iron, and cobalt base alloys. One major objective was verification of a performance calculation method. Therefore, an overhung arrangement was selected with an oil-lubricated pivoted-pad bearing and a duplex ball-thrust bearing for turbine support. A combination argon buffer and potassium hydrodynamic seal was developed to separate the oil and potassium. The 316-type stainless steel facility having a 3000-KW gas-fired boiler has made it possible to test the turbine over a range of temperatures, speeds, and pressure ratios. The turbine blading was designed making liberal use of steam turbine technology. The off-design performance of the turbine was estimated using the characteristics of this blading. Author

N66-31529# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

AN EXPERIMENTAL STUDY OF THE CONDENSING CHARACTERISTICS OF MERCURY VAPOR FLOWING IN SINGLE TUBES

James A. Albers and David Nam Koong, Jr. *In* AIAA AIAA Specialists Conf. on Rankine Space Power Systems, Vol. 1 [1965] p 553–581 refs (See N66-31509 18-22) CFSTI: HC $8.00/MF $4.00

An investigation was conducted to determine the condensing characteristics of mercury vapor flowing in horizontal single tubes. For a crossflow-nitrogen-cooled condenser, flow regime and pressure drop were investigated for nonwetted flow in constant diameter and tapered tubes, under 1 and 0 g, and for wetted flow in tapered tubes under 1 g. For a counterflow-NaK-cooled condenser, heat transfer, inlet pressure, and pressure drop were investigated for a tapered tube under 1 g. Within the limits of the investigation and predicated on SNAP-8 requirements, the results obtained from the nitrogen-cooled condenser indicated no significant influence of gravity on nonwetted condensing pressure drop. Wetted 1-g condensing frictional pressure drop was higher than that of nonwetted only at the higher flow rates in a tapered tube. Data compared with the Lockhart–Martinelli and fog-flow correlations showed deviation from the former and data scatter on the latter. Author

N66-31530# Atomics International, Canoga Park, Calif.

MERCURY RANKINE (SNAP 2) RADIATOR CONDENSER DEVELOPMENT EXPERIENCE

V. H. Heiskala, R. C. Smith, E. A. Elliott, and R. T. Lancet *In* AIAA AIAA Specialists Conf. on Rankine Space Power Systems, Vol. I [1965] p 582–640 refs (See N66-31509 18-22) CFSTI: HC $8.00/MF $4.00

(Contract AT(11-1)-GEN-8)

Radiator condenser (RC) concepts which have been designed, fabricated, and tested for the mercury Rankine program (SNAP 2) are presented. These include conical steel fin-steel tube honeycomb, conical aluminum fin-steel tube, and flat copper fin-steel tube radiator condensers. The emissivity coating development program, which has been carried on concurrent to the RC development program, is outlined along with applicable coating test experience. Thermal and structural component testing and prototype system mockup test experience (PSM-1, PSM-3) are summarized. Steady-state RC heat transfer, pressure drop, and stability characteristics are predicted and compared to experimental data resulting from system testing with a horizontal RC and from testing in a single tube condensing rig. One- and two-dimensional heat transfer models of the RC are shown and the relative accuracy of the two models is compared. The results calculated from these heat transfer models are shown to be in good agreement with experimental data. The pressure drop model, which is based on the fog flow theory of Koestel but uses the two-phase flow friction factor correlation of Baroczy and Sanders (Model 2), is recommended for mercury condensing pressure drop calculations. Types of instabilities which can occur during RC operation are discussed along with criteria for determining the limits of stability. Results are discussed as a photographic study of instabilities encountered in a glass tube in a single tube condensing rig. Author

N66-31531# Aerojet-General Corp., Azusa, Calif. SNAP-8 Div.

DESIGN AND DEVELOPMENT OF THE SNAP-8 MULTITUBE CONDENSER

A. H. Kreeger and J. N. Hodgson *In* AIAA AIAA Specialists Conf. on Rankine Space Power Systems, Vol. 1 [1965] p 641–668 refs (See N66-31509 18-22) CFSTI: HC $8.00/MF $4.00

(Contract NAS5-417)

The design, development, and testing of the condenser for this SNAP-8 electrical generating system marks one of the major accomplishments of the SNAP-8 Program. The SNAP-8 system condenser is a counterflow tube-in-shell heat exchanger. It consists of 73 tapered tubes surrounded by a tapered shell. Mercury condenses inside the tubes. The shell-side fluid is a sodium-potassium eutectic mixture (NaK) which flows through the condenser as part of the heat-rejection system. The tube configuration is designed to permit operation with a stable liquid-vapor interface in a zero-gravity environment. Author

N66-31532# General Electric Co., Cincinnati, Ohio. Space Power and Propulsion Section.

THERMAL AND FLUID DYNAMIC PERFORMANCE OF POTASSIUM DURING CONDENSATION INSIDE A TUBE

S. G. Sawochka *In* AIAA AIAA Specialists Conf. on Rankine Space Power Systems, Vol. I [1965] p 669–693 refs (See N66-31509 18-22) CFSTI: HC $8.00/MF $4.00

(Contract NAS3-2528)

Forced convection heat transfer and pressure change data for the condensation of potassium inside a vertical tube are presented and discussed. These data, obtained at saturation temperatures up to 1400°F and heat fluxes up to $3(10^5)$ Btu/hr-ft^2, provide a reasonable basis for the thermal design of potassium space power system condensers. A comparison of analytical and measured fluid temperature profiles is given which indicates that estimation of local potassium temperatures from measured condenser inlet and outlet temperatures is of questionable accuracy for calculation of reliable condensing heat transfer coefficients. The response of the test condenser to a change in location of the liquid-vapor interface is discussed. Author

N66-31534# Oak Ridge National Lab., Tenn.

DESIGN AND DEVELOPMENT TESTS OF DIRECT-CONDENSING POTASSIUM RADIATORS

A. P. Fraas *In* AIAA AIAA Specialists Conf. on Rankine Space Power Systems, Vol. I [1965] p 716–736 refs Sponsored by AEC (See N66-31509 18-22) CFSTI: HC $8.00/MF $4.00

Six tapered tube direct condensing radiators have been built and operated in the course of the boiling potassium reactor system development test program, and a number of tests have been run with individual tubes. The bases for the design of these units and the more significant results of the test program are summarized, and some implications relative to future design work are discussed. Author

N66-31624*# Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.

EXPERIMENTAL PROGRAM TO INVESTIGATE STABILITY, COMPATIBILITY AND CORROSION OF POISON SOLUTIONS AND STRUCTURAL MATERIALS. TASK B: FEASIBILITY OF A CHEMICAL POISON LOOP SYSTEM Summary Report

D. N. Fultonberg and G. R. Taylor Jul. 1966 128 p refs

(Contract NAS3-5215)

(NASA-CR-54995; WCAP-2867) CFSTI: HC $4.00/MF $1.00 CSCL 18J

The experimental programs and the associated facilities, designed to investigate the compatibility of various combinations of nuclear poison solutions and structural materials, are described. The discussion of the test results and the conclusions drawn are aimed at allowing an assessment of the feasibility of utilizing a chemical poison loop system for the reactivity control of a tungsten–water moderated rocket reactor. Reference poison solutions containing cadmium sulfate and reference structural materials of 316 stainless steel and Zircaloy-2 were subjected to low temperature and pressure beaker tests, high temperature and pressure autoclave tests and high temperature and pressure circulating loop tests. Author

N66-31689*# Argonne National Lab., Ill.
IMPURITY AND LIQUID LEVEL MEASUREMENTS FOR THE FARET LOOP
A. G. Hosler (AEC, Chicago, Ill.) and F. A. Smith *In its* Proc. of the Conf. on Appl. of High Temp. Instrumentation to Liquid-Metal Expt. [1965] p 413–425 refs (See N66-31671 18-33) CFSTI: HC $6.75/MF $3.25

The self-seeking level probe and the sodium impurity levels in the fuel assembly flow test loop are discussed. Details are given on the liquid level probe of the sodium storage tank used with the fast reactor test facility loop. Its electrical components are mentioned, the circuitry is diagrammed, and the operation is described. Chemical and mass spectrometric analyses of the sodium in the test loop were performed, and the concentrations and corrosion rates of the Cr, Fe, and Ni impurities are presented. N.E.N.

N66-31829# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
MERCURY-BOILING FUSED-SALT FAST REACTOR "WARS"
M. Taube, S. Poturaj-Gutniak, A. Kowalew, and M. Mielcarski Apr. 1966 14 p refs
(Rept.-706/C) CFSTI: HC $1.00/MF $0.50

The present paper discusses the concept of a new type mercury-boiling fused salt fast reactor, WARS. The fuel consists of: $^{239}PuCl_3$—fissionable material, $^{238}UCl_3$—fertile material and NaCl and/or KCl—diluent. Metallic mercury was chosen as primary cooling agent. Liquid mercury is pumped into the fused salt giving dispersed system. Then it is heated to the boiling temperature. The boiling heat of mercury is a decisive element of heat balance in this type of reactor. Outlet mercury vapor is moderately superheated. Author

N66-31843# United Kingdom Atomic Energy Authority, Springfields (England).
DISPERSED CERAMIC FUELS AND THE ADVANCED GAS-COOLED REACTOR
R. W. M. D'eye 1966 14 p refs Presented at the Dragon Contractors' Res. and Develop. Symp., AERE, Mar. 1966 Reprint of TRG Memo. 3218(S)
(TRG-1210(S); TRG-MEMO-3218(S)) HMSO: 1s 3d

The results of a study to select and economically assess an all-ceramic fission product retaining fuel, namely a uranium carbide coated with pyrolytic carbor and coated spheres dispersed in a matrix of silicon carbide, are briefly reviewed. The four stages in the fabrication route leading to the development and production of a suitable fuel pin are summarized. The physical and mechanical properties together with the irradiation trials of fuel pins are mentioned to indicate that the conditions required by the economic assessments are feasible. Author

N66-31870# United Kingdom Atomic Energy Authority, Risley (England). Reactor Group.
BIBLIOGRAPHY ON LIQUID METALS, 1958–1963
S. H. Fenney 1966 110 p refs
(TRG-312(R)) HMSO: 13s

A bibliography is presented on liquid metals, with particular emphasis on sodium and sodium–potassium alloys. The references cover the areas of analysis, purification, compatibility, corrosion, handling, safety, heat transfer, instruments, pumps, and properties. R.N.A.

N66-31921# European Atomic Energy Community, Brussels (Belgium).
CHARACTERISTICS OF FAST NEUTRON POWER REACTORS
M.-Th. Beyens-Henry Apr. 1966 167 p refs
(EUR-2766.e) CFSTI: HC $3.25/MF $1.00

This report lists the most important features of each of 19 reactors or reactor projects complete with a short bibliography and diagrams of essential parts. Diagrams have been taken from the various reports. The aim is to give, as far as possible, exhaustive data. This means that those projects for which too little information is available or which have been abandoned are not included. Author

N66-31936*# General Dynamics/Fort Worth, Tex. Nuclear Aerospace Research Facility.
A STUDY OF SOME REACTOR SHIELDING PROBLEMS FOR SPACECRAFT APPLICATIONS
E. E. Jones and M. B. Wells 29 Oct. 1962 114 p refs
(Contract NAS8-1573)
(NASA-CR-76529; FZK-154) CFSTI: HC $3.00/MF $0.75 CSCL 18F

Machine programs for computing the single-scattered neutron and gamma-ray fluxes from radiators of reactor-powered spacecraft are described and some calculated results for typical unshielded SNAP-8-powered spacecraft are presented. Calculations to investigate the effect of uniform expansion of a direct-beam shield on the transmitted neutron dose rate in the absence of a scattering atmosphere are reported. The results of some Monte Carlo calculations to investigate the effects of shield-splitting on neutron transmission through direct-beam shields in the absence of a scattering atmosphere are discussed. Author

N66-31940*# General Motors Corp., Indianapolis, Ind.
GASEOUS-FUELED CAVITY REACTORS—CRITICALITY CALCULATIONS AND ANALYSIS
Washington, NASA, Jul. 1966 164 p refs
(Contract NAS3-6073)
(NASA-CR-487; EDR-3997) CFSTI: HC $5.00/MF $1.00 CSCL 18K

Calculations were made with an IBM 7094 Mod II computer to determine the effect of certain material, temperature, and dimensional variables on the criticality and size of a gaseous fueled cavity reactor for nuclear rocket propulsion. The computer codes used in the calculations are discussed, including code routines containing terms of the transport equation or those in which the convergence criterion is established and tested. The DTK transport code was used for one-dimensional calculations, and the DDK code was used for two-dimensional calculations. Both codes are capable of solving inhomogeneous problems with a fixed source, searching for the reactivity, performing a time absorption

study, searching for fuel concentration, and determining a zone thickness or a critical radius. Cross sections calculations are presented for plutonium, deuterium oxide, carbon, beryllium oxide, beryllium, niobium, and hydrogen. A mathematical procedure to develop the average group-to-group transfer cross sections of deuterium and oxygen is also given. L.E.W.

N66-31951# Brown Boveri/Krupp Reaktorbau G.m.b.H., Dusseldorf (West Germany).

THTR (THORIUM HIGH TEMPERATURE REACTOR) Status Report, 1965

Brussels, EURATOM, May 1966 128 p Prepared jointly with Kernforschungsanlage

(Contract EURATOM-003-63-1 RGAD)

(EUR-3000.e; THTR-4) CFSTI: HC $3.00/MF $1.00

Development work on the thorium high temperature reactor (THTR) is discussed, and progress in several areas is reported. Schematics of the 300 MWe prototype, planned as part of the German atomic program, are shown, its economic advantages are assessed, and its main characteristics are discussed. Special engineering problems are considered. Details are given on the design of fuel elements and structural graphite; fuel element fabrication; experimental studies on the THTR heat exchangers; irradiation, and neutron physics investigations; and the fuel element cycle. M.G.J.

N66-31954# United Kingdom Atomic Energy Authority, Windscale (England).

RESONANCE CAPTURE CALCULATIONS FOR GAS-COOLED REACTORS

J. G. Tyror, A. Hart, J. E. Beardwood, and J. D. Mac Dougall 1966 25 p refs Presented at Am. Nucl. Soc. Topical Meeting, San Diego, Calif., Feb. 1966 Submitted for Publication

(TRG-1225(W)) CFSTI: HC $1.00/MF $0.50

The report reviews the evidence available from the analysis of graphite-moderated oxide fuel lattices which suggests that the available theoretical methods and associated nuclear data lead to over-estimates of resonance capture. Author

N66-31955# India. Dept. of Atomic Energy, Bombay.

THEORETICAL REACTOR PHYSICS STUDIES Annual Progress Report, 1965

B. P. Rastogi 1966 25 p refs

(AEET-248) CFSTI: HC $1.00/MF $0.50

Abstracts of papers, reports and internal notes on various physics problems encountered in reactor design, operation, optimization, and fuel cycle studies are presented. The bibliography is categorized into these areas: general studies, computer codes for studies pertaining to heavy water moderated reactors, neutron thermalization, resonance absorption, transport theory, reactor control, nuclear data and special studies. In an introductory statement, specific achievements from these investigations are pointed out. H.S.W.

N66-31977# Atomic Energy of Canada, Ltd., Chalk River (Ontario).

THE EFFECT OF DENSITY AND GRAIN SIZE ON THE THERMAL CONDUCTIVITY OF UO_2 DURING IRRADIATION

M. Aragones and H. Guerrero Apr. 1966 52 p refs

(AECL-2564) CFSTI: HC $2.00/MF $0.50

Eight Hydraulic Rabbit specimens were irradiated in the NRX facility for three minutes. From the extent of melting in the UO_2 fuel, values of $\Lambda(\theta_s, \theta_m)_p$** were calculated. The differences due to variations in density from 10.5 to 10.8 g/cm^3 were given by the expression:

$$\Lambda(\theta_s, \theta_m)_p = \Lambda(\theta_s, \theta_m)_o \, |1 - (2.8 \pm 1.0)\rho|$$

Increasing the grain size from 10 μm to 100 μm did not appreciably alter the value of $\Lambda(\theta_s, \theta_m)_p$ in UO_2 with a density of 10.8 g/cm^3. Author

N66-32126# Thompson Ramo Wooldridge, Inc., Cleveland, Ohio. TRW Electromechanical Div.

MERCURY RANKINE POWER CONVERSION PROGRAM: MERCURY MATERIALS EVALUATION AND SELECTION GFY 1964 Topical Report No. 29

James F. Nejedlik May 1965 53 p refs Prepared for Atomics International

(NAA-SR-6321; TRW-ER-6265) Available from AEC, Oak Ridge, Tenn.: $3.45 (Declassified)

Reflux capsule corrosion screening tests were made of several nickel-, cobalt-, and iron-base alloys at 400–800°F. Classifications were made for use of these materials in a mercury environment on the basis of weight changes and penentration. Metal capsule tests at 800–1200°F indicated diffusion controlled corrosion for Haynes Alloy 25, PH15-7Mo and Croloy 9M. Weight losses and penetrations generally ranged on the average about four-fold greater than corresponding glass reflux capsule results. A thermal convection two-phase Haynes Alloy 25/PH15-7Mo loop which duplicated an earlier test substantiated corrosion data obtained previously. This showed that corrosion obtained in loop tests is reproducible. Inhibition of corrosion in a Haynes Alloy 25 loop was shown to be feasible. This was accomplished by two methods: a titanium–magnesium pretreatment; and a titanium source in a cold leg. Materials corrosion test results indicate a one-year life capability for the present MRPC reference materials. Author

N66-32346# Atomics International, Canoga Park, Calif.

THERMAL BEHAVIOR OF SNAP REACTOR FUEL ELEMENTS DURING ATMOSPHERIC REENTRY

A. W. Barsell, L. D. Montgomery, and J. E. Arnold 25 Mar. 1966 122 p refs

(Contract AT(11-1)-GEN-8)

(NAA-SR-11502) CFSTI: HC $4.00/MF $1.00

Trajectory transient calculations are made for SNAP-10A reactor fuel elements released from the reactor vehicle at selected altitudes between 200,000 and 400,000 ft. The aerodynamic heating, transpiration cooling, and the chemical reactions of the fuel with air are analyzed to determine the net surface heat flux to the elements. An analytical model is described with which simultaneous solutions of the heat and hydrogen transport equations are obtained including variable material properties and material phase changes. A detailed evaluation of available information concerning fuel material properties is given. Using the best available data, minimum fuel element ejection altitudes are estimated from which complete ablation of the fuel can be achieved. The computations are performed for fuel element trajectories with cross-axial-spinning, end-over-end-tumbling, and random-tumbling flight orientations. A statistical analysis of the computations is presented, from which probabilities of initial fuel ablation are derived as a function of release altitude. The statistical procedure is concluded to be a valid and optimum method of analysis. Data from experimental tests on the transient heating and burnup of the fuel material

in a hyperthermal wind tunnel are used to correlate the analytical description. The agreement is found to be good and within deviation due to uncertainties in parameters.
Author (NSA)

N66-32347# Atomics International, Canoga Park, Calif.
IRRADIATION BEHAVIOR OF URANIUM MONOCARBIDE FUEL EXPERIMENTS NAA 81-3 AND AI 3-12
J. L. Arnold 25 May 1966 53 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-11140) CFSTI: HC $3.00/MF $0.50

Two UC fuel capsules were successfully irradiated to peak burnups of 10,400 and 17,800 Mwd/MtU at temperatures in the 1400 to 1800°F range. The fuel used in these experiments was 0.49-in. dia. as-cast hypostoichiometric UC, with the exception of a 4-in. column of slightly hyperstoichiometric fuel slugs in the lower burnup capsule. The total length of fuel in each fuel rod was 18 in. The fuel was sodium bonded to 0.010-in. thick type 304 stainless steel cladding. The lower burnup capsule (NAA 81-3) was irradiated in the Materials Test Reactor (MTR) for a total of 3126 hr at power. The fuel from this experiment was stable and sound, with the exception of the two fuel slugs which were hyperstoichiometric UC; these slugs had experienced some gross macrocracking. The fuel had a very low fission gas release (0.24% of that theoretically produced) and low fuel growth (1.7 to 2.8% density decrease). The C content of the two hyperstoichiometric fuel slugs had been reduced to essentially the stoichiometric composition for UC. The higher burnup capsule (AI 3-12) was irradiated in the General Electric Test Reactor (GETR), utilizing a Radially Adjustable Facility Tube (RAFT) for a total at 6265 hr at power. The fuel was borken and cracked over much of the length of the fuel rod, with the worst cracking (appearance of coarse gravel) occurring in the two slugs which had in-fuel thermocouple holes along their axial centerlines. The rest of the fuel was broken into pieces, ~1 in. in length. The fuel growth again was low, with density decreases ranging from 3.5 to 7.2%. A definite correlation between fuel composition and fuel growth was found; in that, by increasing the C content, the irradiation stability was increased. Examination of the cladding showed that there had been no fuel-cladding reaction, except for some slight carburization. Even the fuel rod which had the hyperstoichiometric UC did not show extensive carburization of the type 304 stainless steel cladding. The cladding in both fuel rods performed successfully as a containment for fission gas during operation. However, the fission gas from the AI 3-12 fuel rod was lost during disassembly, due to the fracture of a Nicrobraze joint between the in-fuel thermocouple and the top end cap. Author (NSA)

N66-32350# Battelle Memorial Inst., Columbus, Ohio.
PROGRESS RELATING TO CIVILIAN APPLICATIONS DURING FEBRUARY, 1966
Donald L. Keller 1 Mar. 1966 31 p
(Contract W-7405-ENG-92)
(BMI-1765) CFSTI: HC $2.00/MF $0.50

Progress is reported in studies on reactor materials and components, fuels, PuN–UN fuel materials, development of a portable smoke photometer, coated-particle fuel materials, and corrosion of materials used in the fluidized-bed fluoride-volatility process. NSA

N66-32351# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
THE EFFECTS OF IRRADIATION AND ENVIRONMENT ON THE MECHANICAL PROPERTIES OF INCONEL-ZIRCALOY TRANSITION JOINTS
J. E. Irvin and T. T. Claudson Feb. 1966 39 p refs
(Contract AT(45-1)-1830)
(BNWL-190) CFSTI: HC $2.00/MF $0.50

Transition joints between Inconel 600 and Zircaloy-2 were irradiated at 550°F to integrated exposures of 6.2×10^{20} nvt (>1 Mev). The integrity of these joints is not impaired by exposures under conditions typical of the BONUS Reactor. Tensile tests at 550°F and room temperature indicate the life of the transition joints will probably be limited by the Zircaloy-2 portion of the tube. A large decrease in ductility was observed after irradiation in the Zircaloy-2 portion of one type of transition joint. Hydrogen pickup was greatest in this particular joint, and is believed to be partially responsible for the marked loss in ductility. Hydride gradients were observed near the transition joints. The mechanical property changes and hydrogen pickup are definitely influenced by the prior fabrication history of these transition tubes. Author (NSA)

N66-32355# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
FABRICATION COSTS FOR PLUTONIUM FUEL ELEMENTS PART D: VARIABLE COST OF FABRICATING UO_2–PuO_2 FUEL ELEMENTS FOR THE PLUTONIUM RECYCLE TEST REACTOR
C. H. Bloomster Oct. 1965 22 p
(Contract AT(45-1)-1830)
(BNWL-131-D) CFSTI: HC $1.00/MF $0.50

The variable (shop) cost of fabricating the HPD fuel element for the PRTR is $113/kg of fuel (as oxide) or a unit cost of $3900 per fuel element. The costs are based on the fabrication of the first 24 fuel elements by the pneumatic impaction–vibrational compaction processes. The shop labor requirements for each fuel element are 113 man-hours direct labor and 44 man-hours indirect labor. The variable costs include direct materials, some processing costs for nuclear materials, shop labor, direct overhead, and consumable supplies. Each fuel element contains 19 fuel rods and 34.6 kg of natural UO_2–2wt % PuO_2 fuel. The fuel rods are 170 cm long and 1.4 cm OD with 0.76 mm Zircaloy-2 cladding. The fuel length is 149 cm, and an 18 cm plenum extends above the fuel. NSA

N66-32358# Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.
IREKIN—PROGRAM FOR THE NUMERICAL SOLUTION OF THE REACTOR KINETICS EQUATIONS
R. J. Wagner Jan. 1966 84 p refs
(Contract AT(10-1)-205)
(IDO-17114) CFSTI: HC $3.00/MF $0.75

The IREKIN program solves the one-group, space-independent, differential equations that describe the power behavior of a nuclear reactor in response to an arbitrary function of reactivity. In addition, the code yields numerical solutions to other ordinary differential equations which might be used to describe a particular model of reactor behavior. These additional differential equations may describe feedback mechanisms representing the dependence of the reactivity of the system upon time, reactor power, and energy release. The reactivity can be represented as an arbitrary function of time, power, energy, and the other variables which may have been specified in the differential equations. Operation and use of the code on the IBM 7040 are described. NSA

N66-32363# Los Alamos Scientific Lab., N. Mex.
HYDRO—A SMALL, WATER-COOLED, AND WATER-REFLECTED NEUTRON SOURCE
William Bernard 14 Mar. 1966 30 p refs
(Contract W-7405-ENG-36)
(LA-3374) CFSTI: HC $2.00/MF $0.50

A remotely controlled, portable critical assembly that uses enriched uranium metal is described. The operation of the assembly is discussed briefly together with some applications of the assembly. NSA

N66-32371# India. Dept. of Atomic Energy, Bombay.
KERN AND PAR PROGRAMS FOR COMPUTING SCATTERING KERNELS IN H_2O, D_2O AND POLYETHYLENE
S. V. Lawande 1966 18 p refs
(AEET-246) CFSTI: HC $1.00/MF $0.50

This report describes a program for the computation of kernels for thermal neutrons scattered inelastically from chemically bound target nuclei in moderators. The main program that achieves this is called KERN. The two auxiliary programs PAR I and PAR II compute the specific input parameters for KERN according to either Nelkin Honeck model for H_2O, D_2O or Goldman model for polyethylene. The programs use Fortran language. Author

N66-32372# India. Dept. of Atomic Energy, Bombay.
INCINERATION OF LOW-LEVEL RADIOACTIVE SOLID WASTES AND GAS CLEANING—SOME OPERATIONAL EXPERIENCES
K. T. Thomas, A. A. Khan, and R. V. Amalraj 1966 25 p refs Presented at Symp. on Treatment of Low and Intermediate Level Radioactive Wastes, Vienna, 6–10 Dec. 1965; Sponsored by Intern. Atomic Energy Agency
(AEET-243) CFSTI: HC $1.00/MF $0.50

The design and operational details of a plant for treatment of typical alpha contaminated waste containing corrosive chemicals are discussed. The incinerator furnace, ducts, and layout of the plant are described. Combustion in the furnace, cooling of hot flue gases, and flue gas filtration were studied, and, based on the experience gained, a new plant was designed and installed for regular treatment of all common types of low level radioactive wastes. Higher grades of materials and workmanship were employed and a sophisticated instrument system provided. Furnace and accessories, ducts, gas cleaning equipment, and instrumentation of the newer plant are described, and operational details of the 100 lb/hr incinerator plant are given. It was felt that the second plant would provide better performance due to an improved design of the incinerator furnace with respect to combustion efficiency. The effluent from the multichamber furnace operating at a high temperature is relatively free from pyrolytic products, thereby improving the lifetime and economics of the filtration system. L.E.W.

N66-32377# European Atomic Energy Community, Brussels (Belgium).
SURVEY MEASUREMENTS ON THE OPTIMALISATION OF THE SCATTERER SHAPE FOR A COLD NEUTRON SOURCE
L. Olivi and R. Misenta May 1966 20 p ref
(EUR-2953-e) CFSTI: HC $1.00/MF $0.50

The output of subthermal neutrons was measured for differently shaped lucite samples in a graphite stack which simulated a tangential beam hole of a reactor. The samples were cooled to liquid nitrogen temperature. The obtained values were normalized to the output of a circular slab by the introduction of a shape factor. The measurements show that an elliptical slab in the reflection position and a black body shaped scatterer have gain factors by 20–50% higher than a circular scatterer of the same thickness. The usual gain factor, which is defined as the neutron output at high temperature to that at low temperature is for all shapes between 2.5 and 3. Author

N66-32419# Douglas Aircraft Co., Inc., El Segundo, Calif. Missile and Space Systems Div.
NUCLEAR PROPULSION AND MANNED INTERPLANETARY FLIGHT
R. W. Hallet, Jr. [1965] 32 p Presented at the Atomic Ind. Forum, Washington, D. C., 17 Nov. 1965
(Douglas Paper-3763)

The activation of a manned interplanetary landing mission is contingent upon two requirements: (1) establishing a mission date consistent with sufficient lead time to permit an orderly progression of mission studies, support programs, research and technology programs, and development of the operational hardware from birth to activation—a total time period of 15 to 20 years, and (2) the acceptance of such a mission as a national goal and the confirmation that related expenditures fall well within our economic means. The paper treats two types of missions—a 960-day mission employing chemical propulsion, and a 460-day mission employing nuclear propulsion. On the basis of such factors as schedule of critical milestones, effect of mission duration upon physiological and psychological stamina of the astronauts, relation of the launch date to the solar flare cycle, requirement for a new post-Saturn launch vehicle, and annual expenditures, it is concluded that a 460-day mission utilizing nuclear rockets and occurring during the year 1984 is consistent with our technological and economic capability. Author

N66-32456# Reactive Metals, Inc., Ashtabula, Ohio. Extrusion Plant.
[EXTRUSION STUDIES OF URANIUM FUEL ELEMENTS] Quarterly Progress Summary, Oct.–Dec. 1964
18 Mar. 1966 86 p refs
(Contract AT(30-1)-1405)
(RMI-4) CFSTI: HC $3.00/MF $0.75

Extrudability vs grain structure investigations were continued on the Mark V-B; 7-3/8 in. O.D. billets were extruded using various ram speed–billet temperature combinations to study their effect on extrudability and extrusion grain structure. Various methods of eliminating or reducing coarse I.D. grain structure associated with Mark VE-I extrusion were investigated, but double extrusion did not appear attractive from a cost standpoint. The heating of uranium tubing for production roll straightening by the electrical resistance method was investigated on a laboratory basis and results were promising. The I.D. grain refinement was accomplished by extrusion over a tipped mandrel. Extrusion of the Mark VE-I tube with a water cooled mandrel was completed. The practice appeared adaptable to production processing and would reduce mandrel costs. Piercing activity was changed from the Mark V-B to the Mark VE-O billet size because of the phasing out of the Mark V-B fuel element. Author

N66-32465# Bettis Atomic Power Lab., Pittsburgh, Pa.
HISTORY OF THE NRX REACTOR X-1-q AND X-3-n TESTS AND THE NONDESTRUCTIVE POST-IRRADIATION EXAMINATION OF THEIR PLATE-TYPE CERAMIC FUEL ELEMENTS

H. B. Meieran Mar. 1966 155 p refs
(Contract AT(11-1)-GEN-14)
(WAPD-TM-455) CFSTI: HC $5.00/MF $1.00

A series of plate-type ceramic fuel elements were irradiated in the NRX Reactor X-1 and X-3 loops to investigate the effects of bulk fuel density, fuel temperature, fissioning rate, and the addition of trivalent and quadrivalent metals on the irradiation behavior of certain ceramic fuel materials. Different thermal conditions were obtained by varying the thickness, composition, and density of the ceramic fuel material, and by performing the irradiations in different pressurized water loop environmental conditions. By carefully controlling the loop environmental conditions and by periodic non-destructive interim examination of the test specimens, the behavior of the elements could be followed closely, and irradiation terminated when test criteria were satisfied or exceeded. Examination of the nondestructive data revealed the relative thermal differences in performance between those elements irradiated at 1500 psi and those at 2000 psi pressurized water, the thermal performance limits of plate-type ceramic fuel elements, the enhanced lifetimes resulting from lower power outputs, and the relation between thickness and volume swelling. The mode of irradiation induced volume swelling previously postulated for plate-type ceramic fuel elements was verified in this test series.

Author (NSA)

N66-32473# Oak Ridge National Lab., Tenn. Health Physics Div.
FEASIBILITY STUDY: INTENSE 14-MEV NEUTRON SOURCE FOR OPERATION HENRE
T. G. Provenzano, E. J. Story, F. F. Haywood, and H. T. Miller May 1966 65 p refs
(CEX-65.01) CFSTI: HC $1.00/MF $0.75

The design and fabrication of a high-intensity, 14-Mev neutron source which can be operated on a hoist platform on the 1500-ft BREN tower at the Nevada Test Site (NTS) was determined to be feasible. Utilizing the $T(d,n)^4He$ reaction, the source should be capable of producing, as a minimum, an average intensity of 10^{13} neutrons/sec for periods up to 4 hr. The type and placement of power supplies, ion sources, targets, and vacuum equipment were examined and a preliminary conceptual design completed. Control systems, testing procedures, and construction operations were studied and are presented. It is estimated that the neutron source will cost from $260,000 to $300,000, occupy approximately 400 ft^3, weigh approximately 7.5 tons and require about 10 months to complete.

Author (NSA)

N66-32474# Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.
IRRADIATION TESTS OF URANIUM METAL TUBES FOR D_2O—COOLED REACTORS
Stephen R. Nemeth, comp. Feb. 1966 65 p refs
(Contract AT(07-2)-1)
(DP-1019) CFSTI: HC $3.00/MF $0.75

Dimensional changes in experimental uranium metal tubular fuel elements exposed in the heavy water components test reactor (HWCTR) are described. The irradiation tests simulated conditions in a pressurized heavy-water-moderated-and-cooled power reactor. The Zircaloy-clad coextruded fuel elements were approximately 2 inches outside diameter and up to 10 feet long. Tests were conducted at metal temperatures up to 500°C, reactor pressures up to 1200 psi, and exposures up to 6800 Mwd/te U. The uranium metal fuel tubes that contained dilute (<1000 ppM) Fe, Si, and Al additions performed better (<3% volume change) than the U–1.5 wt % Mo, the U–2 wt % Zr alloys, or the unalloyed uranium tubes (6–10% volume change). Irradiation results for Zr–9.3% enriched uranium HWCTR driver fuel tubes and Th–1.4% enriched uranium fuel tubes are also presented. The performance of both of these fuels was satisfactory; volume changes of 5.0% at 1.83 atom % burnup for the Zr–9.3% U alloy and <1% at 3500 Mwd/te Th–U for the Th–1.4% U alloy were observed.

Author (NSA)

N66-32475# Atomics International, Canoga Park, Calif.
CALANDRIA REMOTE MAINTENANCE TOOL DEVELOPMENT
L. Newcomb 15 Apr. 1966 86 p
(Contract AT(11-1)-GEN-8)
(NAA-SR-11202) CFSTI: HC $3.00/MF $0.75

Methods were studied and equipment designed for installation and maintenance of process channels and moderator graphite in the calandria core of the large SGR. Development and testing of the conceptual remote-maintenance tooling for separating and sealing top and bottom process tube joints and the tooling for installing moderator graphite were performed. Equipment was designed, manufactured, and tested to determine maintainability of both brazed and welded joints. Tooling was also developed and tested for remote installation of graphite filler logs in the calandria vessel.

Author (NSA)

N66-32498# Coast Guard, Washington, D. C. Office of Engineering.
SNAP-7A ISOTOPIC POWER SUPPLY FOR BUOYS Test Report
J. E. Wesler 2 Mar. 1966 22 p
(Rept.-437; AD-632991) CFSTI: HC $1.00/MF $0.50

One SNAP-7A system was evaluated for approximately four years since its original delivery by the contractor. The performance of the SNAP-7A system deteriorated much more rapidly than predicted, so that its performance after four years is below that predicted at the end of its expected ten-year life. The fault appears to be a deterioration of the thermoelements in the thermoelectric generator of the system.

Author (TAB)

N66-32500# Ballistic Research Labs., Aberdeen Proving Ground, Md.
SECONDARY GAMMA RAY TRANSMISSION THROUGH PLANE SLABS OF CONCRETE
Alfred J. Budka and Thomas J. Dolce Sep. 1965 130 p refs
(BRL-R-1307; AD-633216) CFSTI: HC $4.00/MF $1.00

Secondary gamma ray transmission data are presented for monoenergetic secondary gamma ray sources in concrete slabs of various thicknesses. The data presented have been computed using the Monte Carlo method. These secondary gamma ray transmission data along with an appropriate weighting scheme allow one to determine the secondary gamma ray transmission information for any depth distribution of secondary gamma rays in plane concrete slabs.

Author (TAB)

N66-32556# European Atomic Energy Community, Brussels (Belgium).
PROPOSAL OF A NEW COLD NEUTRON FACILITY. DESIGN STUDY OF A CROSS CHOPPER

H. Meister and H. Geist May 1966 69 p refs
(EUR-2964.e) CFSTI: HC $2.50/MF $0.75

The considerations displayed in this report refer to a cold neutron facility of the type fixed crystal with chopper. The special idea of the arrangement proposed is to use large Bragg-angles. By this mean we obtain for a predetermined value of the energy resolution high intensities, as large angular divergencies in the primary reactor beam are allowed. By using a new method of double Bragg-reflection, the normal disadvantage of large Bragg-angles, i.e., the monochromatic beam tends back towards the reactor block, is cancelled. The performance data claimed at the very beginning of our calculations are specified for elastic neutron scattering work: small wave length spread $(\Delta\lambda/\lambda)1/2=0.01$, values of the angular divergencies (with respect to sample and detectors) and of the time of flight resolution adapted to the wave length spread. With these input data our proposed facility, which we install for a thought experiment at the largest beam hole of the reactor Ispra-I (12" ϕ at the reactor core), supplies us with a mean neutron current through the sample (duty cycle included) of about 2.10^7 neutrons per minute. Author

N66-32558# Aktiebolaget Atomenergi, Stockholm (Sweden).
A SUMMARY REPORT ON ASSEMBLY 3 OF FRO
T. L. Andersson, B. Brunfelter, P. F. Cecchi, E. Hellstrand, J. Kockum et al Jun. 1966 39 p refs
(AE-233) CFSTI: HC $2.00/MF $0.75

The third core of the zero energy fast reactor FRO consisted of 20% enriched uranium diluted to 29 vol. % with graphite and had a volume of 50 litres. Like previous cores it was surrounded by a thick copper reflector. The report summarizes measurements of critical mass, control rod reactivities, fine structure flux variations and conversion ratio. In particular, effects associated with the heterogeneous arrangement of the uranium and graphite plates are examined. Author

N66-32565# Atomic Energy of Canada, Ltd., Chalk River (Ontario).
THE PHYSICS OF LATREP
I. H. Gibson Mar. 1966 142 p refs
(CRRP-1235; AECL-2548)

The computer code LATREP written in the Apex Language for the AECL G-20 machine calculates reactor lattice parameters. The basic physics of the code is described in detail as is the input data required; details of the coding are however not given. Author

N66-32629*# Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.
TEST AND ANALYSIS OF DESIGN OF A MANIFOLD AND REENTRANT TUBE ASSEMBLY, TASK 3A: FEASIBILITY OF A CHEMICAL POISON LOOP SYSTEM Summary Report
F. C. Engel and A. A. Bishop Jul. 1966 89 p refs
(Contract NAS3-5215)
(NASA-CR-54994; WCAP-2870) CFSTI: HC $2.50/MF $0.75
CSCL 18J

An analytical and experimental model study was performed of a manifold and re-entrant tube chemical poison distribution system which are part of a rocket reactor control loop. The system operates by changing the concentration of the poison (cadmium sulfate) in a water solution circulating through a large number (198) of parallel tubes which project from a manifold into the core. In order to meet the specifications that (1) the flow rate through all the tubes be uniform, (2) the injected chemical poison arrive at the top of the core within 0.2 second and (3) the chemical solution concentration variation throughout the core should be within ±5%, a special manifold and re-entrant tube assembly was designed and a full size flow model was constructed of plexiglas and a series of tests performed to prove the design. Author

N66-32650# United Kingdom Atomic Energy Authority, Harwell (England). Research Reactors Div.
LIQUID-HYDROGEN EXPLOSIONS IN CONTAINMENT VESSELS
D. G. Pearce, D. L. Ward, and P. Hayes Feb. 1966 82 p refs
(AERE-R-4584) HMSO: 12s

The hazard evaluation of liquid-hydrogen moderator chambers in nuclear reactors demands a containment vessel that will prevent reactor damage should a fault occur permitting an explosion of liquid hydrogen and condensed solid air. A series of explosions of liquid hydrogen and solid air were performed in closed vessels. The proportions of hydrogen and air, the quantities in relation to the containment volume, and the containment volumes and L/D ratio themselves, were all varied, and the resulting pressures, variations, and peak pressures were measured against time. The results are analysed here and compared with theoretical analyses. The dynamic response of typical containment vessels suitable for use in nuclear reactors is considered and compared with the time characteristics of the explosion forces. Author

N66-32659# Aktiebolaget Atomenergi, Stockholm (Sweden).
CALIBRATION OF THE FAILED-FUEL-ELEMENT DETECTION SYSTEMS IN THE AGESTA REACTOR
O. Strindehag Jun. 1966 57 p refs
(AE-231) CFSTI: HC $2.50/MF $0.50

Results from a calibration of the systems for detection of fuel element ruptures in a reactor are presented. The calibration was carried out by means of foils of zirconium-uranium alloy which were placed in a special fuel assembly. The release of fission products from these foils is due mainly to recoil and can be accurately calculated. Before the foils were used in the reactor their corrosion behavior in high temperature water was investigated. The results obtained with the precipitator systems for bulk detection and localization are in good agreement with the expected performance. The sensitivity of these systems was found to be high enough for detection and localization of small defects of pinhole type. The general performance of the systems was satisfactory during the calibration tests, although a few adjustments are desirable. Author

23 PHYSICS, GENERAL

Includes acoustics, cryogenics, mechanics, and optics. For astrophysics see: 30 Space Sciences. For geophysics and related information see also: 13 Geophysics; 20 Meteorology; and 29 Space Radiation.

N66-31613# Weapons Research Establishment, Salisbury (Australia).
A METHOD BASED ON MODULATION TRANSFER TECHNIQUES FOR THE FOCUSSING AND ASSESSMENT OF OPTICAL SYSTEMS UNDER FIELD OR LABORATORY CONDITIONS

F. A. Dixon Apr. 1966 23 p refs
(ISD-72) CFSTI: HC $1.00/MF $0.50

A compact system has been developed to measure the modulation transfer function of optical systems over any specified spatial frequency range. Alternatively the modulation transfer factor for a particular spatial frequency may be monitored and used to select the focal setting giving optimum performance at this spatial frequency. The system is suitable for use under either field or laboratory conditions. Author

N66-31615# Naval Research Lab., Washington, D. C.
REPORT OF NRL PROGRESS
May 1966 49 p refs
(PB-169968)

CONTENTS:

1. INELASTIC ELECTRON SCATTERING AT 180 DEGREES FROM MAGNESIUM L. W. Fagg, W. L. Bendel, R. A. Tobin, T. F. Godlove, and H. F. Kaiser p 1–4 refs (See N66-31616 18-24)
2. GALACTIC AND EXTRAGALACTIC X-RAY SOURCES E. T. Byram, T. A. Chubb, and H. Friedman p 5–8 (See N66-31617 18-29)
3. CHEMISTRY Marianne K. Bernett et al p 9–10 ref
4. ELECTRICITY E. E. King et al p 11–14
5. MECHANICS C. D. Porter p 15–16 ref
6. METALLURGY AND CERAMICS C. N. Freed et al p 16–32 refs
7. OPTICAL PHYSICS I. Schneider et al p 32–33 refs
8. RADIO L. O. Hayden et al p 34–35 refs
9. SOUND W. M. Lawson, Jr. p 35–36
10. AN INLET FOR THE INTRODUCTION OF COLLECTED GAS CHROMATOGRAPHIC FRACTIONS INTO A MASS SPECTROMETER F. E. Saalfeld and R. A. Saunders p 37–38 refs
11. LEAD COUPLING DEVICE FOR REACTOR EXPERIMENTAL ASSEMBLY F. J. Loss and R. F. Bryner, Jr. p 38–39

N66-31622# Applied Physics Lab. Johns Hopkins Univ., Silver Spring, Md.
SCALING THE EFFECTS OF AIR BLAST ON TYPICAL TARGETS
Harold S. Morton Jan. 1966 107 p refs
(Contract NOw-62-0604-c)
(TG-733; AD-481144)

The interactions between shock waves, produced in air by detonation of explosives, and specific targets which they can destroy by air blast are described. A mathematical analysis is used which relates weights of explosive (or yields of nuclear devices) to the distances at which they can cause lethal damage over the entire range of blasts from a few pounds of conventional high explosive to kilotons or megatons of nuclear blast. Effects at sea level and higher altitudes are examined. In the analysis, typical targets are defined by two parameters for which specific numerical values can be established. Shock waves produced by detonation of specific explosives are similarly defined in mathematical terms which relate characteristics of the explosive to the ambient atmosphere. A dimensionless scaling parameter is the key to the scaling relationships derived.
Author (TAB)

N66-31705*# Carnegie Inst. of Tech., Pittsburgh, Pa. Dept. of Electrical Engineering.
OPTICS OF A BIREFRINGENT PLATE WITH APPLICATIONS TO ELLIPSOMETRY
Dale Arthur Holmes [1965] 195 p refs
(Contract NAS8-5269)
(NASA-CR-76443) CFSTI: HC $3.25/MF $1.25 CSCL 20F

The ellipsometric measurement of the optical properties of mechanically stressed single crystals of GaAs is considered. GaAs becomes anisotropic when stressed, therefore, the crystal optics problem of electromagnetic wave reflection from a birefringent specimen is theoretically investigated using the Maxwell equations. It is found that the geometrical optics description is inadequate when retardation plates and rotary compensators are used for precise measurements in well collimated, monochromatic light. A very general method for using a compensator in ellipsometry is outlined. A new type of retardation plate, which uses an isotropic rather than an anisotropic plate, is proposed. Detailed consideration is given to the methods for determining the optical constants of unstressed GaAs and the piezo-optical constants of stressed GaAs through the use of ellipsometry data. An infrared ellipsometer, with a specimen chamber designed so that stress can be applied to a GaAs specimen and using a GaAs injection laser source, is described. Author

N66-31708# California Univ., Livermore. Lawrence Radiation Lab.
CALCULATIONS OF THE SHOCK WAVE FROM A NUCLEAR EXPLOSION IN SALT: PROJECT SALMON
Leo A. Rogers 6 May 1965 30 p refs
(Contract W-7405-ENG-48)
(UCRL-12326) CFSTI: HC $2.00/MF $0.50

Calculations (SOC Computer Code) of shock pressure, position, velocity, and material displacement were made for the Salmon detonation (design yield of 5 kt). Preshot calculations based on results from the Gnome event (3.1 kt in salt) and postshot calculations based mostly on the physical properties measurements of the material in the shot region were made. Comparison of the calculations with preliminary experimental data gives agreement for peak pressure and peak velocity within 20 to 50% over the range calculated (1–600 meters). The calculated time-of-arrival of the shock front was within 1 to 10% of the experimental data. Calculated displacements of the salt at 300 meters were within 25% of the experimental data, and ground surface motion directly above the shot was within 10 to 50% of the preliminary experimental data. The postshot calculations generally gave better agreement with the data, since several errors and difficulties in the preshot calculations were corrected. No arbitrary adjustment of code input parameters (parameter studies) was made to force the postshot calculations to agree with the experimental data. Author (NSA)

N66-31710# California Univ., Livermore. Lawrence Radiation Lab.
CALCULATION OF FIRST-ZONE, P-WAVE AMPLITUDES FOR SALMON AND DISTANT DECOUPLING
Donald L. Springer 17 May 1965 26 p refs
(Contract W-7405-ENG-48)
(UCRL-12328) CFSTI: HC $2.00/MF $0.50

Theoretical calculations of the first half-cycle amplitudes of the P-wave at 250 km to 1000 km are made from source functions representing several types of nuclear explosions in salt. Specifically, they are Gnome scaled to 5 kton; Salmon; a theoretical 25-kton detonation in a cavity built to fully decouple a 5-kton explosion; and a theoretical 5-kton detoanstion in a 5-kton cavity. The calculations consist of a series of convolutions of the source functions plus the attenuation

operators plus the instrument response. Amplitude factors are calculated using Zvolinskii's near-front approximation for various assumed crustal models. Experimental amplitudes from Salmon fall below the amplitude curve for the scaled Gnome source. They are consistent with amplitudes for the Salmon source. Amplitudes calculated for the fully decoupled 5-kton source show a decoupling of 200. Those from the overdriven cavity source indicate a partial decoupling of 80 can be gained by overdriving a fully decoupling cavity by a factor of 5. Author (NSA)

N66-31720# California Univ., Livermore. Lawrence Radiation Lab.

QUANTUM ELECTRODYNAMICS ON A COMPUTER

William D. Schulz 23 Apr. 1965 15 p ref

(Contract W-7405-ENG-48)

(UCRL-14127) CFSTI: HC $1.00/MF $0.50

The possibility of solving a field theory on a computer is considered using quantum electrodynamics as a model. It is shown that in a proper machine calculation, renormalization can be ignored. A fully quantized formulation of the electromagnetic field which has no renormalization difficulties is presented. NSA

N66-31726# Tennessee Univ., Knoxville. Ultrasonics Lab.

BASIC RESEARCH ON THE PROPERTIES OF MATTER USING ULTRASONIC WAVES

M. A. Breazeale Feb. 1966 52 p refs

(Contract Nonr-4289(01))

(TR-1; AD-631332) CFSTI: HC $5.60/MF $0.50

CONTENTS: M. A. Breazeale, "Finite Amplitude Waves in Liquids and Solids", Proceedings of the 5th ICA, Liege, Vol. Ia, D18 (1965). A. L. Van Buren and M. A. Breazeale, "Distorted Wave Interaction at Boundaries", J. Acoust. Soc. Am. 38, 931 (A) (1965). Charles Ross Endsley III, "A Study of Devices for the Concentration of Ultrasonic Waves", M. S. Thesis, The University of Tennessee (1965). A. L. Van Buren, "Wave Interactions at Plane Boundaries". A. A. Gedroits and V. A. Krasil'nikov, J. Exptl. Theoret. Phys. (USSR), 43, 1592 (1962). M. A. Breazeale and D. O. Thompson, Appl. Phys. Lett., 3, 77 (1963). A. Hikata, B. Chick and C. Elbaum, Appl. Phys. Lett., 3, 195 (1963). TAB

N66-31753# Los Alamos Scientific Lab., N. Mex.

PRESSURE OSCILLATIONS INDUCED BY FORCED CONVECTION HEATING OF DENSE HYDROGEN

R. S. Thurston, J. D. Rogers, and V. J. Skoglund (New Mexico Univ.) 1966 32 p refs Presented at the Cryog. Eng. Conf., Boulder, Colo. Prepared jointly with New Mexico Univ.

(Contract W-7405-ENG-36)

(LA-DC-7806; CONF-660605-1) CFSTI: HC $2.00/MF $0.50

Pressure oscillations of a thermal-acoustic nature with predictable frequencies are discussed. The understanding of these oscillations is extended by establishing a limiting condition for the computation of acoustic frequencies, a correlation for correction of the computed frequencies, and correlations for the inception and amplitude of oscillations. The nondimensional correlation of conditions for the inception of thermal-acoustic oscillations is based on original data for hydrogen in a straight 1/4-in. tube. However, it applies to other fluids and geometries, including the data of Platt and Wood for liquid oxygen in 3/4-in. coils. At low subcritical pressures two-phase properties are used in the correlations. Near the critical pressure the correlations employ quasi two-phase properties based on considerations of the liquid and gaseous behavior of hydrogen in this region. The characteristics of fluid temperature and flow rate fluctuations accompanying thermal-acoustic oscillations are presented. Author (NSA)

N66-31767*# Stevens Inst. of Tech., Hoboken, N. J.

APPLICATION OF FORMAL POWER SERIES TO SOME CLASSICAL PROBLEMS OF MECHANICS Final Report

Lawrence Goldman [1966] 28 p refs

(Contract NsG-403)

(NASA-CR-76433) CFSTI: HC $2.00/MF $0.50 CSCL 12A

Analytic results derived from the algebraic functions, coordinates, and derivatives of the three-body problem were extended to the n-body problem, and to the restricted three-body problem, for small values of parameter μ. These previous negative results were extended to the n-body problem, and it was found that no algebraic function of the coordinates and their derivatives is an exponential. Similar results are obtained for a large class of problems in mechanics, including practically all celestial mechanics problems. Formal power series for algebraic systems are applied to a mechanical system on n-degrees of freedom, (S), and a system of seond order differential equations is derived. Therefrom, a theorem is postulated were (S) has r irreducible manifolds of order 2n, and it is seen that any two such manifolds are isomorphic. R.Ll.

N66-31865# National Bureau of Standards, Washington, D. C.

COMPUTATION OF THE PERMEABILITY AND PERMITTIVITY OF A RELATIVELY SMALL RING SAMPLE IN A TOROIDAL COIL

Eric G. Johnson, Jr. 25 Jan. 1966 45 p ref

(NBS-TN-311) GPO: $0.30

The derivation and the Fortran machine program are presented for a formula which gives the impedance of a partially filled toroid coil. This formula shows the relationship of the complex permeability and permittivity of the ring material, the dimensions of the coil and sample, and the frequency of the applied electromagnetic field. Limitations of the formula due to proximity of the ring and coil, range of permeability and permittivity of the ring, and uniformity of the coil winding are considered. The cost of the program in terms of computer time is also considered. The principal value of the formula is to accurately determine the permeability and permittivity of ferrites. Author

N66-31903*# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.

[RESEARCH LABORATORY OF ELECTRONICS] Quarterly Progress Report No. 81

H. J. Zimmermann and G. G. Harvey 15 Apr. 1966 287 p refs

(Contract NSR-22-009-120; Grants NsG-296; NGR-22-009 (114); NGR-22-009-131; NsG-334 et al)

(NASA-CR-76504) CFSTI: HC $3.75/MF $1.50 CSCL 20

This report contains a review of electronics research activities in the areas of microwave spectroscopy, radio astronomy, optical and infrared spectroscopy, high magnetic fields, upper atmosphere physics, X-ray diffraction, physical acoustics, electrodynamics of moving media, plasma physics, gaseous electronics, plasmas and controlled nuclear fusion, energy conversion, spontaneous radio frequency emission from hot electron plasmas, interaction of laser radiation with plasmas and nonadiabatic motion of particles in magnetic fields, statistical communication theory, information processing and

transmission, linguistics, cognitive information processing, communications biophysics, neurophysiology, and computation research. R.N.A.

N66-31911# Technisch Documentatie en Informatie Centrum voor de Krijgsmacht, The Hague (Netherlands). Advies Bureau der Genie.

AIR AND HEAT RESISTANCE CAPABILITIES OF DUST FILTERS [LUCHTWEERSTAND EN WARMTE-OPNEMEND VERMOGEN VAN GRINDFILTERS]

W. F. Kuypers Jan. 1966 20 p In DUTCH *Its* Rept.-134 (TDCK-45623) CFSTI: HC $1.00/MF $0.50

Tests were conducted to determine the loss of air pressure as a function of the amount of processed air by filters consisting of various sizes of crushed stone, and to determine how much warmth is absorbed by the stone from the hot air passing through the filter. Results are graphically presented, and the data indicate that the size of the crushed stone has an important effect on the measured air resistance, and on the maximum warmth absorption. The porosity percentage was also found to have an effect, with the lowest porosity percentage correlating with the 5 to 10 mm stones. Transl. by J.O.

N66-31950# College of Aeronautics, Cranfield (England).

EXACT SUBHARMONIC OSCILLATIONS

P. A. T. Christopher Dec. 1965 19 p refs
(CoA-AERO-190) CFSTI: HC $1.00/MF $0.50

It is demonstrated that a certain class of nonlinear differential equations of second-order, representative of various physical situations, possesses exact periodic solutions which are subharmonics of the forcing frequency. Conditions for the asymptotic stability and, thereby, the physical existence of these subharmonics are also obtained. Author

N66-31968# McGill Univ., Montreal (Quebec). Soil Mechanics Lab.

SOIL–VEHICLE INTERACTION STUDY

R. N. Yong, C. W. Boyd, and S. J. Windisch Aug. 1965 18 p refs Presented at 5th Meeting, Quadripartite Working Group on Ground Mobility, Kingston, Ontario *Its* Soil Mech. Ser. No. 14
(D-PHYS-R-(G)-MISC-21) CFSTI: HC $1.00/MF $0.50

The soil–vehicle interaction study program of the Soil Mechanics Laboratory of McGill University is presented. Primary emphasis is focussed on the response behavior of the soil under transient superficial loading imparted either by tracked or wheeled vehicles. The incorporation of an X-ray technique to measure translocation of particles within the subsoil, coupled with an analysis based on incremental strains and energy relationships will provide for a description of soil behavior under vehicular loading. The technique has been fully developed and shown to be successful whilst the analysis itself is still in the stage of development. The test facility described shows the instrumentation of the test vehicle (in this instance a rigid wheel), the soil bin and the measurement system. Whilst these are essentially standard in general practice, several innovations may be noted. Parameters and dynamic scaling are also discussed. Author

N66-32119*# Macneal-Schwendler Corp., San Marino, Calif.

ANALYSIS OF THERMAL TEST ERRORS RESULTING FROM IMPERFECTLY COLLIMATED SOLAR SIMULATION BEAMS. APPENDIX A: RELATIVE ENERGY FLUX DENSITY AND RELATIVE ENERGY IN PENUMBRAE OF VARIOUS SHADOWING OBJECTS

Edwin J. Gooze Jun. 1966 773 p Prepared for JPL
(Contracts NAS7-100; JPL-951330; MSC Proj. EC-34)
(NASA-CR-76463) CFSTI: HC $8.23/MF $3.50 CSCL 20F

This volume contains tabulated data which are applicable to two general classes of shadowing bodies and three distinct nonuniform solar simulator sources. The shadowing bodies are classified as a black skirt or a black rectangular cylinder. The data represent relative energy flux density and relative energy; absolute values of energy flux density and total energy in the penumbra caused by the black skirt or black rectangular cylinder being illuminated by any one of three solar simulator sources. The data include a range of solar field angles which are 0.5°, 2.0°, 5.0°, and 10.0°. Positive and negative receiver angles from 0° to nearly 90° by 10° increments are included. R.N.A.

N66-32174# Aerospace Research Labs., Wright-Patterson AFB, Ohio.

SEQUENTIAL LIGHT AMPLIFIER SYSTEM

Radames K. H. Gebel [1965] 31 p U.S. Patent 3,217,099, 9 Nov. 1965

This document contains the patent specifications and schematic circuit drawings for a sequential light amplifier system. The purpose of the invention is to provide a light amplification system for use in military and scientific fields to observe objects or to photograph objects at light levels for which the human eye or present photographic systems with short exposures are not sufficiently sensitive. The system's light sensing element is a photocathode which coverts photons into electrons and also has a certain electron emission, called the dark current, when there are no incident photons. The system can detect objects of low brightness and discriminate between objects of low contrast down to the limitation imposed by random fluctuations of the dark current and the random nature of the photon to electron conversion process. Details of the systems various components are also described. R.N.A.

N66-32318# Gt. Brit. Ministry of Aviation, London. Technical Information and Library Services.

CALCULATING THE PARAMETERS OF THE DETONATION WAVE IN CONDENSED EXPLOSIVES [RASCHET PARAMETROV DETONATSIONNOI VOLNY V KONDENSIROVANNYKH VESHCHESTVAKH]

A. Y. Apin and I. M. Voskoboinikov Jun. 1966 9 p refs Transl. into ENGLISH from Zh. Prik. Mekhan. i Techn. Fiz. (Moscow), v. 4, 1960 p 54–55
(TIL/T.5635) CFSTI: HC $1.00/MF $0.50

In the calculation of the parameters using the five equations of the hydrodynamic theory of detonation the degree of successful calculation depends largely on the choice of the equation of state of the explosion products. It is shown that the choice is not satisfactory and empirical relationships are proposed, based on experiments, to substitute for this equation. Calculated and experimental values of the detonation wave parameters are presented. Author

N66-32376# Institut Franco-Allemand de Recherches, St. Louis (France).

ABERRANT IMAGE OF A TWO-DIMENSIONAL OPAQUE IMAGE IN PHASE CONTRAST AND IN SCHLIEREN PROCESS BY SYMMETRIC OR ASYMMETRIC SCREENS [IMAGE ABERRANTE D'UN OBJET OPAQUE BIDIMENSIONNEL EN CONTRASTE DE PHASE ET EN STRIOSCOPIE, PAR ECRANS SYMETRIQUES OU DISSYMETRIQUES]

P. Smigielski 3 Jun. 1965 23 p refs In FRENCH
(ISL-T-16/65) CFSTI: HC $1.00/MF $0.50

The effect of the diffraction phenomena inherent in the phase contrast and schlieren method with symmetric or asymmetric screens during visualization of hypersonic aerodynamic processes is investigated. Mathematical expressions are given for such diffraction phenomena for static opaque objects. The results, together with holography, are intended as a base for extensive investigations of the visualization of thin phase objects near opaque objects. Transl. by K.W.

N66-32446# Los Alamos Scientific Lab., N. Mex.
PRESENT STATUS OF THE ANALYSIS OF THE ARC SPECTRUM OF URANIUM (UI)
David W. Steinhaus, Jean Blaise and Michele Diringer (Centre Natl. de la Rech. Sci., Bellevue, France) 20 Apr. 1966 184 p refs
(Contract W-7405-ENG-36)
(LA-3475) CFSTI: HC $5.00/MF $1.00

The calculated rectangular array and line list (6121 lines) of UI are presented for all allowed lines from the known levels (35 odd, 394 even). Experimental wave number values are given for 3376 of these lines, and experimental isotope shift (U^{235}–U^{238}) values for 1530 of them. Although the upper and lower levels for many strong lines are certain, the description and analysis of this spectrum are far from complete. Wave number measurements exist for only about 10% of the estimated number of lines measurable with modern high resolution apparatus. Author (NSA)

N66-32496# Aberdeen Proving Ground, Md. Human Engineering Labs.
MAXIMUM NOISE LEVEL FOR ARMY MATERIEL COMMAND EQUIPMENT
Robert F. Chaillet and Georges R. Garinther Jun. 1965 13 p Supersedes Hel-S-1-63A, Jun. 1964
(HEL-S-1-63B; HEL-S-1-63A; AD-632913) CFSTI: HC $1.00/MF $0.50

The standard establishes the maximum noise level permitted at personnel occupied spaces of equipment designed, developed or procured by AMC. It establishes the testing requirements for determining conformance to the maximum noise level permitted. TAB

N66-32599# Bureau of Mines, Pittsburgh, Pa. Explosives Research Center.
AN IMPROVED METHOD FOR EVALUATING THE INCENDIVITY OF EXPLOSIVES TO COAL DUST Progress Report
Norman E. Hanna, Paul A. Richardson, and Robert W. Van Dolah 1966 21 p refs
(BM-RI-6815)

Experience with the current version of gallery test 4, in use since 1913 to evaluate the incendivity of permissible explosives in the presence of coal dust, has shown the procedure to have inadequate discrimination. Consequently the Bureau of Mines used the up-and-down method of statistical design to investigate the incendivity of permissible explosives in the presence of coal dust and gas. A suitable device was developed to measure coal dust concentrations in the air-gas mixtures and to disperse the dust in the gallery atmosphere. A proposed testing method which uses suspended shots in a predispersed coal dust-gas-air mixture was evaluated. The new method can discriminate between different explosives with respect to their incendivity. Maximum ignitibility of the coal dust cloud by permissible explosives occurred in the vicinity of 0.3 oz/cu ft. About 10 percent sodium chloride in permissible explosive formulations had a very significant effect in reducing the probability of igniting coal dust. Bundled charges were more incendive than column charges. Author

N66-32649# United Kingdom Atomic Energy Authority, Harwell (England). Metallurgy Div.
MEASUREMENT OF ANODIC AND CORROSION FILMS BY OPTICAL INTERFERENCE
N. J. M. Wilkins Mar. 1966 45 p refs
(AERE-R-5175)

Since the correlation between colours on certain oxidized metals and the interference colours produced by thin air films was established in the early 1920's, optical interference measurements have been used from time to time in corrosion research. A variety of experimental methods are now used, but this paper will be confined to measurements directly involving the wavelength of interference minima or maxima, determined either by colour or spectrophotometrically. Colour comparison is still a valuable, if limited, technique. However, spectrophotometric measurements, taking advantage of wavelengths in the ultraviolet and infra-red regions are now being more widely developed. The experimental techniques are simple. Interpretation of results is often complicated, and some methods of deriving the relation between film thickness and interference are discussed. An appendix on the measurement of anodic and corrosion films by multiple beam interference techniques is included. Author

N66-32675*# Union Carbide Corp., Tonawanda, N. Y. Linde Div.
CRYOPUMPING–CRYOSORPTION ARRAY SYSTEM FOR A 3"×3" VACUUM FACILITY Final Report
May 1966 23 p
(Contract NAS5-5881)
(NASA-CR-76835) CFSTI: HC $1.00/MF $0.50 CSCL 20M

Test results are summarized for a cryopumping–cryosorption array system. It was established that the overall design and performance was satisfactory and within the required specifications. Ultimate system pressures in the high 10^{-14} to low 10^{-13} torr range were attained during the testing period. Pumping speeds for hydrogen gas exceeded the specified array value based on a 0.16 sticking coefficient for the adsorbent panels. Satisfactory thermal performance was demonstrated while operating a 50 watt heat load inside the test volume. The vacuum integrity of the system with its associated flanges and interface connections was shown by bagged helium mass spectrometer leak tests. The overall cleanliness of the system and the integrity of the bonded sieve panels was successfully demonstrated when no traceable contaminants were found. Performance tables are appended. Author

24 PHYSICS, ATOMIC, MOLECULAR, AND NUCLEAR

Includes atomic, molecular, and nuclear physics. For applications see: 22 Nuclear Engineering. For related information see also: 29 Space Radiation.

N66-31539# Massachusetts Inst. of Tech., Cambridge. Dept. of Metallurgy.
DIFFUSE DOUBLE DIFFRACTION OF X-RAYS Technical Report No. 8
S. L. Strong and Roy Kaplow 6 Apr. 1966 25 p refs
(Contract Nonr-1841(48))
(DSR-7954; AD-633057) CFSTI: HC $1.00/MF $0.50

A Monte Carlo method has been used to evaluate the magnitude of twice scattered X-rays in diffraction experiments. The

quantitative effects of variations in the primary scattering distribution, the absorption coefficient, the scattering power of the atoms, the X-ray wavelength, the specimen thickness, the monochromator and slit configuration and of polarization corrections have been derived. These factors have various influences on the magnitude and angular distribution of the twice scattered radiation. Author (TAB)

N66-31543# Cornell Univ., Ithaca, N. Y. Lab. of Atomic and Solid State Physics.
ELECTRON SPIN RESONANCE OF THE ICl^- V_K-CENTER Technical Report No. 7
Marvin L. Meistrich and Lawrence S. Goldberg May 1966 13 p refs
(Contracts Nonr-401(54); Nonr-401(47))
(TR-2; AD-633423) CFSTI: HC $1.00/MF $0.50

The electron spin resonance of the ICl^- V_K-center was observed in KCl:I:Pb below 35° K. By reorienting the centers with polarized light, the ESR spectrum was greatly simplified. The parameters of the spin-Hamiltonian were calculated and are consistent with the proposed model of V_k-centers.
Author (TAB)

N66-31573# Boston Coll., Chestnut Hill, Mass.
A NEW DIRAC BISPINOR FORM OF MAXWELL'S EQUATIONS AND ITS ROLE IN A THEORY OF ELEMENTARY INTERACTIONS Final Report Part III, 1 Oct. 1964–1 Apr. 1965
Darryl J. Leiter 23 Aug. 1965 16 p refs
(Contract AF 19(604)-8819)
(AFCRL-65-855; AD-632417) CFSTI: HC $1.00/MF $0.50

Using the relativistic-operational concept of elementary interaction, the author shows that it is possible to write Maxwell's equations in a bi-spinor form similar to that of the bi-spinor Dirac equation. In the context of a theory of elementary interactions, new electromagnetic interactions are introduced in a natural way through the use of the bi-spinor Maxwell equations in a Lagrangian formalism. In particular a new 'spinor torque' interaction occurs in addition to the usual 'Lorentz force' interaction. The physical effects of this new electromagnetic interaction in a theory of elementary interactions are discussed. Author (TAB)

N66-31618# Naval Research Lab., Washington, D. C.
INELASTIC ELECTRON SCATTERING AT 180 DEGREES FROM MAGNESIUM
L. W. Fagg, W. L. Bendel, R. A. Tobin, T. F. Godlove, and H. F. Kaiser *In its* Rept. of NRL Progr. May 1966 p 1–4 refs (See N66-31615 18-23)

Targets of natural magnesium and magnesium-26 have been bomarded with 39-MeV electrons. For electrons scattered at 180 degrees, inelastic peaks have been observed at nuclear excitation energies of 10.6, 13.4, 16.3, and 18 MeV in magnesium-26 and of 10.7 MeV in natural magnesium. A comparison of the intensities obtained from the two targets show that the 10.7-MeV peak probably comes from magnesium-24. A refrigerated gaseous target of natural neon has been bombarded preparatory to the bombardment of a similar neon-22 target.
Author

N66-31653# Air Force Cambridge Research Labs., Bedford, Mass. Optical Physics Lab.
MOLECULAR BEAMS
A. T. Stair, Jr. *In* Office of Aerospace Res. Proc. of the OAR Res. Appl. Conf. [1966] p 119–129 (See N66-31646 18-34) CFSTI: HC $5.00/MF $1.00

A discussion is given of molecular beams as they may be applied to studying phenomena associated with high velocity vehicles. These are shown capable of supplementing and extending measurements involving shock tubes and wind tunnels. The molecular beam is considered to be the low energy analogue of a high energy accelerator in which single events are observed as a statistical average of many identical events. Related areas are discussed, and include applications of molecular beams, an infrared collision cross section measurement apparatus, a charge exchange molecular beam apparatus, and a mass molecular beam system. C.T.C.

N66-31707# Brookhaven National Lab., Upton, N. Y.
ISOBARIC SPIN SECTION RULES FOR ELECTROMAGNETIC TRANSITIONS
E. K. Warburton [1965] 23 p refs Presented at Conf. on Isobaric Spin in Nucl. Phys., Tallahassee
(Contract AT-30-2-GEN-16)
(BNL-10075; CONF-660306-4) CFSTI: HC $1.00/MF $0.50

The isobaric-spin selection rules for electromagnetic transitions between nuclear levels are discussed along with experimental evidence supporting these rules. N.S.A.

N66-31712# Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires.
CONTRIBUTION TO THE STUDY OF ONCE-FORBIDDEN β TRANSITIONS. CASE OF K-42 AND Rb-86 [CONTRIBUTION A L'ETUDE DES TRANSITIONS β UNE FOIS INTERDITES. CAS DE ^{42}K ET ^{86}Rb
Stephane Andre (M.S. Thesis—Grenoble Univ.) 9 Oct. 1965 86 p refs In FRENCH
(CEA-R-2964)

An apparatus was developed for studying the exact shape of the spectra of β transitions which lead to an excited state of the final nucleus, using a Siegbahn-Slätis β spectrometer. In particular the β spectrum of the $2- \rightarrow 2+$ transition of ^{42}K was measured; a considerable deviation was found with respect to the statistical shape. The six elements of the nuclear matrices for this transition were determined using this measurement and other results. It is shown that it cannot be explained by a pure f 7/2 → d 3/2 transition. Furthermore the value obtained for the ratio of the matrix elements $\int \vec{\alpha}$ and $\int \vec{r}$ is in excellent agreement with that predicted from the theory for the maintained vectorial current. Author (NSA)

N66-31713# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires.
INFLUENCE OF HUMIDITY AND IODINE CONCENTRATION ON THE ADSORPTION OF IODINE-131 BY ACTIVATED CHARCOALS [INFLUENCE DE L'HUMIDITE ET DE LA CONCENTRATION EN IODE SUR L'ADSORPTION DE L'IODE 131 PAR LES CHARBONS ACTIFS]
Francois Billard, Gerard Chevalier, Jacques Caron, and Jean Van Der Meersch Jan. 1966 23 p refs In FRENCH
(CEA-R-2908; CONF-650407-14)

Following an outline of the means of generating iodine-131 in the gas phase and a brief description of the apparatus used, experimental results obtained on the trapping of iodine-131 by activated charcoal were analyzed. The generation of ^{131}I in the gas phase is outlined, and the apparatus used is described. The efficiency depends concurrently on the relative humidity and iodine concentration of the air. While it is independent of this concentration in dry air, it does not exceed 50 in moist air, whatever the bed depth, when the concentration is less than 1 mC/m^3, then it increases with the concentrations to reach values close to those obtained in

dry air for concentrations of around 1000 C/m^3. At the same time the efficiency of a dust filter with respect to iodine remains very low in dry air whatever the iodine concentration; in moist air this efficiency, which is high at low concentrations, decreases when the latter increases. Also, if a charcoal bed is divided, separated by an amount corresponding to a passage time of about a second, it was found that the efficiency of the whole is appreciably higher than that of the initial bed. The results appear to establish the existence of at least two forms of iodine, one molecular form and one particulate form probably formed by clusters, the forms' equilibrium being functions of the relative concentrations of iodine and water vapor in the air. The third form evidence, a gaseous form compound, remains hypothetical; the experimental curves can be explained either by the molecular and particulate forms' reversibility or by the increase of cluster size with the relative humidity of the air. Author (NSA)

N66-31714# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.

NUCLEAR REACTIONS INDUCED BY ^{3}HE [REACTIONS NUCLEAIRES INDUITES PAR ^{3}HE]

Stephane Andre (Ph.D. Thesis) Mar. 1966 23 p refs In FRENCH

(CEA-BIB-68)

It is shown that in the actual state of the theory the surface reactions accompanied by the transfer of a single nucleon, for bombardment energies of over about 10 Mev, are well explained by the DWBA method and provide the most important spectroscopic information. On the other hand, the double-stripping process is still obscure, while at low energies the compound nuclei effects are superimposed on the direct mechanism and make interpretation very difficult. Author (NSA)

N66-31716# General Electric Co., Schenectady, N. Y. Knolls Atomic Power Lab.

SHELL MODEL CALCULATION OF NEUTRON SCATTERING

J. T. Reynolds [1966] 13 p Presented at the Am. Phys. Soc. Meeting, Washington, 25–28 Apr. 1966

(Contract W-31-109-ENG-52)

(CONF-660411-1) CFSTI: HC $1.00/MF $0.50

The cross sections for the elastic and inelastic scattering of neutrons with an energy of about 2.5 Mev from even–even vibrational nuclei with low-lying 2+ states were calculated using the shell model with residual pairing and quadrupole forces. The interaction between the scattering neutron and the target nucleons was represented by a two-body, central, non-exchange potential with a Yukawa shape. The results for ^{52}Cr, ^{56}Fe, and ^{48}Ti were compared with experimental data. NSA

N66-31717# General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science.

A NUMERICAL STUDY OF THE METHOD OF WEIGHTED RESIDUALS

G. C. Pomraning 29 Mar. 1965 40 p refs

(Contract AT(04-3)-187)

(GA-6273) CFSTI: HC $2.00/MF $0.50

The variational method and the region-balance method, both special cases of the more general method of weighted residuals, are each used as the formalism to develop a spatial expansion of the diffusion equation for two problems. These are a spatially dependent spectrum problem for the purpose of computing the self-shielding in the ^{240}Pu resonance and a simple one-dimensional eigenvalue problem. In both instances, the numerical results indicate that the variational method is more accurate than the region-balance method. Of particular interest is the variational spatial expansion approach to the eigenvalue problem. This may be a useful method for deriving a set of difference equations for the multigroup diffusion equation in that it should lead to an accurate representation of the flux with a relatively small number of mesh points. Author (NSA)

N66-31721# Rochester Univ., N. Y. Dept. of Physics and Astronomy.

A NOTE ON A DIFFICULTY WITH THE $\tilde{U}$(12) S-MATRIX THEORY

L. K. Pandit and S. Okubo 24 Mar. 1965 10 p refs Submitted for Publication

(Contract AT(30-1)-875)

(UR-875-79) CFSTI: HC $1.00/MF $0.50

The noncompact group $\tilde{U}$(12) was earlier proposed as a relativistic generalization of SU(6). The possibility that $\tilde{U}$(12) invariance and crossing symmetry of the S-matrix may not be compatible is discussed. NSA

N66-31722# California Univ., Berkeley. Lawrence Radiation Lab.

ON THE CONNECTION BETWEEN THE CONFORMAL GROUP AND THE ULTRAVIOLET SINGULARITIES IN QUANTUM FIELD THEORY

H. A. Kastrup 15 Mar. 1965 36 p refs

(Contract W-7405-ENG-48)

(UCRL-11998) CFSTI: HC $2.00/MF $0.50

The hypothesis that the ultraviolet singularities of quantum field theory are connected with conformal invariance at very high energies is investigated, and it is demonstrated that the singularities can be removed in an elementary way. The main point is that a whole class of new and independent solutions of the field equation is connected with the conformal group. These solutions cannot be described within the framework of the usual test function class S of the distribution calculus. But it is possible to define new test functions which are appropriate for dealing with these new solutions and their essential singularity on the light cone. In the quantum field theory of the Klein–Gordon equation, one now obtains two sets of creation and annihilation operators, the second of which belongs to the new solution. The metric of the Hilbert space concerned is semidefinite and degenerate. It also turns out that the vacuum is infinitely degenerate. But the secondary vacua have a vanishing norm. As an immediate consequence of the semidefinite metric the mass-independent singularities on the light cone of the generalized Green's function cancel each other. Author (NSA)

N66-31723# Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science.

PHOTOPRODUCTION OF SINGLE π^+ AND K^+ MESONS FROM HYDROGEN AT INCIDENT ENERGIES NEAR 4.0 BeV

Virgil Bruce Elings (Ph.D. Thesis) Mar. 1966 79 p refs *ftz* Tech. Rept.-81

(Contract AT(30-1)-2098)

(MIT-2098-223) CFSTI: HC $3.00/MF $0.75

The differential cross sections for the following reactions were measured: $\gamma + p \rightarrow \pi^+ + n$, $\gamma + p \rightarrow K^+ + \Lambda^0$, and $\gamma + p \rightarrow K^+ + \Sigma^0$. The cross sections were measured at incident photon energies from 3.4 to 4.0 Bev and at meson center-of-mass angles from about 25 to 45 degrees. The momenta, velocities, and angles of the mesons were measured using a magnetic spectrometer and the gamma ray energy was determined by doing bremsstrahlung subtractions. The cross

sections, when compared at the same total center-of-mass energy and center-of-mass angle, agree very well with the inequality given by the symmetry theory of SU(3). Author (NSA)

N66-31724# Deutsches Elektronen-Synchrotron, Hamburg (West Germany).

THE PIONIC FORM FACTOR OF THE FIRST πN RESONANCE

F. Gutbrod Feb. 1966 34 p refs

(DESY-66/4)

Off-shell π-N scattering in the 3/2, 3/2-state is treated by the Omnès-Muskhelishvili method. The left-hand cut is represented by nucleon exchange and by approximate double spectral functions coming from iterations of nucleon exchange; on the right-hand cut some inelasticity is assumed. The off-shell amplitude is roughly determined by the behavior of the Born term at resonance energy, but is not insensitive to the absorption at high energies. If the form factor is approximated by a single pole in momentum transfer, the relevant mass is 1.5 nucleon masses. Author (NSA)

N66-31725# Notre Dame Univ., Ind.

N/D CALCULATION OF THE 1688 MeV PION NUCLEON RESONANCE

F. C. Smith and W. R. Johnson [1965] 7 p refs

(Contract AT(11-1)-427)

(COO-427-47) CFSTI: HC $1.00/MF $0.50

The spin-parity assignment of the 1688 Mev π-N resonance was studied using the N/D method to evaluate the $D_{5/2}$ and $F_{5/2}$ partial-wave amplitudes. The results indicate that the 1688-Mev resonance has a spin-parity assignment of $D_{5/2}$. NSA

N66-31737# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France). Faculte des Sciences.

SUM RULES FOR COMPTON SCATTERING, II

M. Gourdin 18 May 1966 31 p refs

(TH/149) CFSTI: HC $2.00/MF $0.50

Presented is an extension of a previous application of the current algebra introduced by Gell-Mann to Compton scattering on a spin 1/2 particle. A brief survey of the notations used in the previous investigation is provided. The equal time commutator contributions are summarized, and a set of general sum rules is written. The case of Compton scattering on nucleons and the implications of gauge invariance and time reversal invariance are discussed. A sum rule for electroproduction is derived using the optical theorem for a forward spin dependent Compton scattering amplitude. H.S.W.

N66-31746# United Kingdom Atomic Energy Authority, Harwell (England).

THE PLANNING OF n–p SCATTERING EXPERIMENTS FOR DETERMINING THE MOST PROBABLE SET OF PHASE SHIFTS

E. Lehar and V. V. Fedorov Nov. 1965 13 p refs Transl. into ENGLISH of Joint Inst. for Nucl. Res. Preprint R-2332 (USSR) Submitted for Publication

(AERE-TRANS-1047) HMSO: 2s 6d

An optimal experiment is planned to distinguish between three sets of phase shifts in n–p scattering at 630 Mev. Author (NSA)

N66-31747# New York Univ., N. Y. Courant Inst. of Mathematical Sciences.

STOCHASTIC WAVE FUNCTION FOR ATOMIC HELIUM

M. H. Kalos [1965] 41 p refs Presented at the Am. Phys. Soc. Meeting, New York, 27–30 Jan. 1965

(Contract AT(30-1)-1480)

(CONF-758-62) CFSTI: HC $2.00/MF $0.50

A method is given for random sampling which yields a density equal to the ground state wave function for the helium atom. As an intermediate step, a Green's function for the diffusion operator containing the repulsive interaction is sampled. A technique for generating a density function proportional to ψ^2 is outlined. Attention is paid to the development of estimators with finite variance. Results are shown for the electron density and for r^2. The latter agrees well with previous numerical results. Author (NSA)

N66-31748# California Univ., Livermore. Lawrence Radiation Lab.

A REVIEW OF THE MEASUREMENTS OF ELECTRON-INDUCED POLARIZED OPTICAL RADIATION NEAR THRESHOLD

Robert H. Mc Farland 23 Mar. 1966 11 p refs Presented at Electron Excitation of Atomic Vapor, Appl. to Spectry. Seminar, Grenoble, France, 23-26 May 1966

(Contract W-7405-ENG-48)

(UCRL-14776; CONF-660512-1) CFSTI: HC $1.00/MF $0.50

Some methods of studying the polarization of the optical radiation produced by electron impact on atoms are briefly discussed together with some measurements of polarization. NSA

N66-31749# California Inst. of Tech., Pasadena.

A MULTI-CHANNEL DOUBLE BOOTSTRAP FOR THE ρ AND K* MESONS

Robert Gerbracht Jan. 1965 70 p refs Submitted for Publication

(Contract AT(11-1)-68)

(CALT-68-26) CFSTI: HC $3.00/MF $0.75

Features of the bootstrap mechanism were investigated in a complex case involving many channels. The ρ meson is generated in the ππ, πω, and $K\bar{K}$ channels, while the K* meson is simultaneously formed in the πK and ηK channels. A single self-consistent solution to the resulting seven coupled equations exists, and the calculation produces predictions for the ρ and K* masses and for the five coupling constants $\gamma\rho\pi\pi$ (or $\gamma\rho\pi\omega$), $\gamma\rho KK$, $\gamma\omega KK$, $\gamma\eta KK^*$, $\gamma\omega KK^*$. Typical results are $M_\rho = 750$ Mev, $M_{K^*} = 900$ Mev, while the prediction for the only experimentally known coupling constant ($\gamma\rho\pi\pi$ or $\gamma\rho\pi\omega$) matches the experimental value. The other coupling constants approximate the values predicted by SU(3) symmetry with the exception of $\gamma\eta KK^*$ and, to a lesser extent, $\gamma\omega KK$. The effects of the φ meson, including φ-ω mixing, the πφ channel, and φ exchange forces, are discussed and estimated. The basic calculational tool is the matrix ND^{-1} technique with the first determinantal approximation—the influence of this approximation is evaluated through a comparison of the results using the approximation with those from solving the exact equations for a suitable test problem. The results apparently justify the use of the approximation. The good results obtained from the calculation demonstrate that the bootstrap idea continues to work even for rather complicated cases, and continues to give sensible answers. Author (NSA)

N66-31750# California Univ., Berkeley. Lawrence Radiation Lab.

EXCHANGE PROCESSES AND $^1S_0$ n–p SCATTERING LENGTH

E. Shield and R. J. Slobodrian 10 Mar. 1965 7 p refs
(Contract W-7405-ENG-48)
(UCRL-11985) CFSTI: HC $1.00/MF $0.50

Neutron–proton scattering is described by a wave function with a short range potential and a wave function without any defined symmetry which satisfies Schroedinger's equation. The individuality of the proton and neutron is questioned and a theory is derived for the scattering length of the $^1S_0$ interaction. NSA

N66-31751# California Univ., Livermore. Lawrence Radiation Lab.

NUMERICAL SOLUTIONS OF THE SCHROEDINGER EQUATION WITH THE COMPLETE SCREENED COULOMB POTENTIAL

Carl A. Rouse 5 Apr. 1965 26 p refs
(Contract W-7405-ENG-48)
(UCRL-12101) CFSTI: HC $2.00/MF $0.50

The complete screened Coulomb potential (CSCP) for a Debye-Hückel ion atmosphere is given by $V(r) = [V(r) = -Ze^2(1/r - 1/d + a), 0 \leq r \leq a$ and $V_0(r) = -Ze^2 (d/d+a) \exp[(a-r)/d]/r, r \geq a]$, where d is the screening length and a is the minimum radius of the ion atmosphere. Some numerical solutions of the Schroedinger equation have been obtained with the CSCP and compared with analytical and numerical solutions with the Coulomb potential. In s-state solutions, it is shown that when a = d = average position of the electron in the Coulomb potential solution, the CSCP yields values of $(\rho R)^2$ reduced by e below the Coulomb values between $a \leq r \leq d$, with eigenvalues increased by e, approximately. A finite electronic partition function is derived that depends on the relative normalization of the CSCP wave functions. Although no explicit maximum bound quantum state is indicated, the normalization integrals for the bound states decrease as the screening length $d \rightarrow 0$.
Author (NSA)

N66-31752# California Univ., Berkeley. Lawrence Radiation Lab.

INFRARED DIVERGENCES IN QUANTUM ELECTRODYNAMICS

Victor Chung (Ph.D. Thesis) 15 Mar. 1966 58 p refs
(Contract W-7405-ENG-48)
(UCRL-16808) CFSTI: HC $3.00/MF $0.75

The infrared divergences of quantum electrodynamics are eliminated to all orders of perturbation theory in the matrix elements by an appropriate choice of initial and final soft photon states. The coherent state formalism of Glauber is used to parameterize these states. It is shown that the condition for the cancellation of the divergences requires that these states belong to representations of the canonical commutation rules which are unitarily inequivalent to the usual Fock representation. A comparison to lowest order is made between this treatment and the conventional treatment whereby the divergences are cancelled in the total cross section.
Author (NSA)

N66-31754# Syracuse Univ., N. Y. Dept. of Physics.

$\bar{U}(12)$ AND UNITARITY

A. P. Balachandran 1965 27 p refs *Its* Rept.-1206-SU-34
(Contract AT(30-1)-3399)
(NYO-3399-34) CFSTI: HC $2.00/MF $0.50

The consequences of applying unitarity to the $\bar{U}(4)$ invariant scattering amplitude of a $\bar{U}(4)$ quartet baryon and a $\bar{U}(4)$ singlet meson are studied in detail. A simple proof is presented to show that if the total amplitude is invariant under the group, then there is no scattering. It is proved by explicit construction that if invariance is insisted upon only for a finite number of partial waves, then there is no contradiction with unitarity alone. However, there is a correlation between these waves which implies that some of the phase shifts vanish at threshold at a rate faster than that required by the finite range of the forces. If invariance is retained for all partial waves, this correlation is compatible with the existence of a partial-wave expansion only if there is no scattering. It is also shown that if $\bar{U}(4)$ is applied only at zero kinetic energy, then with some additional, but reasonable assumptions, one can derive an infinite number of linear equations which relate different partial-wave scattering lengths. The technique developed in this connection should be useful also in analyzing more realistic scattering processes. The different interpretations of the $\bar{U}(12)$ symmetry which have been proposed are examined, and it is suggested that it is perhaps an invariance group only of three-point functions as there does not seem to be any inconsistency between the $\bar{U}(12)$ invariance of a three-point function and its unitary structure. A proof is constructed to show that for processes like $\pi^+\pi^- \rightarrow \pi^+\pi^-$ and $\pi^0\pi^0 \rightarrow \pi^0\pi^0$, the scattering lengths for sufficiently large, even angular momenta are strictly positive. More generally, the scattering length associated with the analytically continued, even-signature partial wave is positive for all sufficiently large, real angular momenta.
Author (NSA)

N66-31755# International Centre for Theoretical Physics, Trieste (Italy).

A HIGH-ENERGY THEOREM BY ALGEBRA OF CURRENTS

S. Okubo 19 Apr. 1966 11 p refs
(IC-66/40)

The algebra of currents theory is used to derive a high-energy theorem for Compton scattering of the nucleon. This theorem may be used, in addition, to distinguish the validity of various elementary particle models. NSA

N66-31756# International Centre for Theoretical Physics, Trieste (Italy).

SATURATION OF U(3)⊗U(2) ALGEBRAS AT INFINITE MOMENTUM TRANSFER

R. Oehme Apr. 1966 16 p refs
(IC-66/39)

The saturation of the current algebras of chiral and collinear U(3)⊗U(3) is explored. The set of states consists of the octet and the decimet of baryons. The matrix elements of the commutators of current densities with the corresponding charges are evaluated at infinite momentum and finite, orthogonal momentum transfer. In the case of collinear U(3)⊗U(3), the infinite momentum is parallel to the direction specified by the algebra. The results are the same for both algebras. They are not consistent with those obtained from collinear U(6)-symmetry. In particular, the f- and d-components of the Pauli magnetic form factors vanish for all values of q^2, and the vector part of the decimet–octet transition matrix element is zero at $q^2 = 0$. The problem of admixtures is discussed only briefly.
Author (NSA)

N66-31757# International Centre for Theoretical Physics, Trieste (Italy).

CHIRAL GROUP WITH A NEW USE OF ITS REPRESENTATIONS

J. C. Taylor Apr. 1966 13 p refs
(IC-66/38)

A new approach to the chiral group SW(3) is proposed. All particles are assumed to be massless in the limit of exact symmetry. Different helicity states of the same physical particle may then be assigned to different SW(3) representations. For example, 0^- mesons and zero helicity 1^- mesons are put together in (8,1)+(1,8), but helicity ±1 vector mesons go in $(3,3^+)+(3^+,3)$. For colinear processes there is a unique frame for defining helicities, and therefore a unique extrapolation to nonzero mass. Assuming the symmetry still approximately valid, several SU(6) results are recovered, including the ratio of magnetic moments. Author (NSA)

N66-31758# General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science.
GACA, A FORTRAN IV CODE FOR CAPTURE AREA ANALYSIS OF LOW-ENERGY NEUTRON RESONANCES
F. H. Froehner, D. L. Huffman, E. Hadad, and W. M. Lopez
15 Feb. 1965 54 p refs
(Contract AT(04-3)-167)
(GA-5816)

The program can be used for the determination of resonance parameters from neutron capture data by area analysis. One can calculate points of the Γ_n versus Γ_γ curve defined by a measured counting-rate sum ("area") under a resonance peak and by a given spin factor. Multiple scattering and instrumental resolution are accounted for. Wing corrections can be made for up to six neighbor resonances. NSA

N66-31761# Kentucky Univ., Lexington. Dept. of Chemistry.
THE NON-DESTRUCTIVE DETERMINATION OF SILICON AND OXYGEN IN METEORITES BY FAST NEUTRON ACTIVATION ANALYSIS
James R. Vogt (Ph.D. Thesis) 1 Apr. 1966 165 p refs
(Contract AT(40-1)-2670)
(ORO-2670-10) CFSTI: HC $5.00/MF $1.00

The development of a highly automated system for rapid and precise fast neutron activation analysis, and its application to the non-destructive determination of silicon and oxygen in a wide variety of stony meteorites is described. An automated pneumatic tube sample transfer system was constructed that permits samples to be sent 200 feet—from a 250 kv Cockcroft-Walton accelerator to a counting room—in less than four seconds. Two solenoid operated pneumatic sample spinner assemblies were built to permit rotation of the samples during irradiation and counting. A solenoid operated beam-stop assembly was developed that permits turning the neutron beam on and off in a time interval on the order of milliseconds. An irradiation control system was designed that permits automatic control of all irradiation and counting processes, and a computer program was developed for automatic processing of the data. Techniques were developed for the non-destructive determination of silicon and oxygen in stony meteorites, and a total of 884 individual analyses were made. An IBM-1410 computer was used to normalize the data for variations in neutron flux, irradiation time, delay time, and dead time. Following normalization the computer calculates an average standard comparator factor from data obtained by irradiation of standards of the element to be determined. Usually one standard sample is run for every 10-20 analyses. The comparator factor is then used to calculate the weight and percent of the element to be determined in each of the samples using the normalized data from the irradiation of the samples. Data are tabulated. NSA

N66-31765# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions.
DIFFRACTION EFFECTS IN THE PROTON TRANSFER REACTIONS
J. Wilczynski and V. V. Volkov 1966 20 p refs
(JINR-E-2580)

A study of the transfer reactions with heavy ions was undertaken to provide information concerning the diffraction effects in these reactions. The proton pickup reactions $^{27}Al(^{12}C, ^{18}N)^{26}Mg$ and $^{12}C(^{12}C, ^{18}N)^{11}B$ were investigated. Angular distributions of the ^{18}N reaction products were measured with a good angular resolution at different energies of ^{12}C ions. The data on the energy distributions of ^{18}N products were also obtained. The angular distributions exhibit diffraction oscillations which damp out as incident energy decreases. The experimental data are compared with predictions of the Frahn and Venter diffraction model and with the theoretical results of Gareyev, Grabowski, and Kalinkin. Author (NSA)

N66-31772# Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati.
STUDY OF THE OPTICAL PROPERTIES OF A HIGH-POWERED MAGNET (SACERDOTI-TAU TYPE) [STUDIO DELLE PROPRIETA' OTTICHE DI UN MAGNETE A FOCHEGGIAMENTO FORTE (TIPO SACERDOTI-TAU)]
B. Borgia (Rome Univ.), P. Joose (Deut. Elektronen-Synchrotron), and M. Grilli 21 Mar. 1966 46 p refs In ITALIAN *Its* Nota Interna No. 314
(LNF-66/15) CFSTI: HC $2.00/MF $0.50

Measurements were made of the optical and magnetic properties of a high-powered magnet; a determination of the focus and path were made by the wire method, and the curve of magnetization, and field index were calculated. Technical construction and optical details are tabulated; the system of coordinates used to define various magnet positions, and optical parameters, calculated by linear approximation, are indicated. The wire and alpha techniques were used to measure focal moment and the current, resolving power and focal distance. Dispersion was measured along a straight line on the principal trajectory and for a focus of d=51 cm, relative to a source 31 cm from the magnet's induction pole. Results indicate that the dispersion measured agrees with the calculation (linear approximation, 0.03 cm^{-1}). R.L.

N66-31775# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France). Faculté des Sciences.
THE ALGEBRA OF CURRENTS AND THE $|\Delta I| = 1/2$ RULE FOR K MESON NONLEPTONIC DECAY
C. Bouchiat and Ph. Meyer Jun. 1966 11 p refs
(TH/155) CFSTI: HC $1.00/MF $0.50

The difficulties occurring in a recent derivation of the $|\Delta I| = 1/2$ rule for the K meson decay into zero energy-momentum pions are removed by a suitable definition of the unphysical amplitude. The selection rule is shown to be valid only in the limit of zero pion mass or in special models. Author

N66-31779# Joint Inst. for Lab. Astrophysics, Boulder, Colo.
FORMAL THEORY OF REARRANGEMENT COLLISIONS
Joseph C. Y. Chen 24 Jun. 1966 34 p refs
(JILA-77)

A general formulation for rearrangement collisions using projection-operator techniques is presented. This formulation is suitable both for multichannel direct reactions and for

multichannel resonant reactions in which intermediate compound states are formed. A method for the construction of projection operators is discussed, and explicit expressions of the projection operators are derived for general three-body rearrangement collisions. Author

N66-31785# Osterreichische Studiengesellschaft für Atomenergie G.m.b.H., Seibersdorf (Austria). Reaktorzentrum.
MULTIPLE ELECTRON SCATTERING IN THIN FOILS
H. Paul and W. Tatzber 1966 36 p refs Submitted for Publication
(SGAE-PH-40/1966) CFSTI: HC $2.00/MF $0.50

A Monte Carlo program has been used to calculate angular distributions of electrons backscattered from or transmitted through thin foils, neglecting energy loss. The single scattering cross sections were taken from the review article by Motz et al. Electron sources were assumed mono-directional or isotropic. The following electron energies (foil materials) were considered: 50, 100, 200 keV (Al) and 100 keV (N and Ag). For a *monodirectional source* and normal incidence, the angular distribution of transmitted electrons is found to agree with Moliere's theory, and an attempt is made to compare the backscattering coefficient to measured transmission values. For oblique incidence, electrons appear to be "reflected" at the surface, and the distributions are similar to those measured by Kanter. Author

N66-31786# Los Alamos Scientific Lab., N. Mex.
ELASTIC AND INELASTIC SCATTERING OF FAST NEUTRONS FROM ^{6}Li AND ^{7}Li
John C. Hopkins [1966] 22 p refs Presented at the Am. Phys. Soc., Conf. of Neutron Cross Section Technol., Washington, D. C.
(Contract W-7405-ENG-36)
(LA-DC-7603; CONF-660303-21) CFSTI: HC $1.00/MF $0.50

The differential elastic and inelastic neutron scattering cross sections of ^{6}Li and ^{7}Li were measured at six scattering angles with an incident neutron energy of 4.83 Mev for ^{6}Li, and with energies of 3.35 and 4.83 Mev for ^{7}Li. Scattered neutrons and gamma rays were observed independently. The neutron cross sections were measured with a neutron time-of-flight spectrometer relative to the well-known cross section for neutron scattering from hydrogen. The gamm-ray spectra were measured with a NaI(Tl) spectrometer, using time-of-flight techniques to eliminate the neutron background. The 2.184-Mev state in ^{6}Li was excited by neutron inelastic scattering and was observed not to decay by gamma-ray emission. Scattered neutrons from the 0.478-Mev state in ^{7}Li were resolved at both incident neutron energies. A continuum of neutrons due to three particle breakup was observed from both ^{6}Li and ^{7}Li at 4.83 Mev. Author (NSA)

N66-31790# Case Inst. of Tech., Cleveland, Ohio. Nuclear Physics Lab.
MUON CAPTURE AND SUPERMULTIPLET SYMMETRY BREAKING IN ^{16}O Technical Report No. 60
George Edward Walker Jun. 1966 186 p refs
(Contract AT(11-1)-720)
(COO-720-060) CFSTI: HC $5.00/MF $1.00

The validity of assuming the equality of the unretarded dipole muon capture matrix elements, $(M_v^1)_{U,D}$, $(M_p^2)_{U,D}$, and $(M_a^2)_{U,D}$ is investigated for muon capture in ^{16}O. Earlier investigations employed supermultiplet theory to obtain $(M_v^2)_{U,D} = (M_p^2)_{U,D} = (M_a^2)_{U,D}$; therefore, the correctness is considered of a supermultiplet grouping of important muon capture nuclear final states as realistic supermultiplet symmetry breaking interactions are included in the nuclear Hamiltonian. The basic wave functions are taken to be simple shell model L–S coupled states belonging to the $(1p)^{-1}2s$ and $(1p)^{-1}1d$ configurations of ^{16}O. Energy eigenvalues and eigenfunctions of various nuclear Hamiltonians are obtained by evaluating the residual interaction matrices that mix the simple basic states. The results indicate that the spin-independent interparticle forces isolate the unretarded dipole muon capture strength in the supermultiplet lying highest in energy. The energy difference between this supermultiplet and lower-lying supermultiplets precludes the large amount of supermultiplet mixing one might expect when tensor and spin-orbit forces are added to the Hamiltonian. Therefore, it is found that the muon capture strength remains concentrated in the giant dipole region and that the muon capture supermultiplet remains substantially pure. In all cases, $(M_v^2)_{U,D} = (M_p^2)_{U,D} = (M_a^2)_{U,D}$ remains a valid assumption to within twelve percent. Author (NSA)

N66-31791# Los Alamos Scientific Lab., N. Mex.
A METHOD OF ASSAY OF ^{235}U, ^{238}U, AND ^{237}NP FISSION FOILS
H. L. Smith and J. P. Balagna [1966] 16 p refs Presented at the Am. Phys. Soc., Conf. of Neutron Cross Section Technol., Washington, D. C.
(Contract W-7405-ENG-36)
(LA-DC-7625; CONF-66303-23) CFSTI: HC $1.00/MF $0.50

A combination of 2π and low geometry α counting was used to assay a set of vacuum-evaporated ^{235}U, ^{238}U, and ^{237}Np foils to be used in the measurement of their relative high-energy neutron fission cross sections. The masses assigned to the uranium foils rest on experimentally determined specific α activities; the neptunium masses depend on low geometry counting and the published half-life. Author (NSA)

N66-31793# Brookhaven National Lab., Upton, N. Y.
THE SPIN POLARIZED HARTREE-FOCK METHOD AND THE CONTRIBUTION OF CORE POLARIZATION TO HYPERFINE FIELDS OF 4D IONS
A. J. Freeman (MIT), P. Bagus (Argonne Natl. Lab.), and R. E. Watson [1964] 8 p refs Presented at the Magnetic Hyperfine Structure of Atoms and Molecules Meeting, Paris, 20–24 Jun. 1966
(Contract AT(30-2)-GEN-16)
(BNL-10040; CONF-660604-1) CFSTI: HC $1.00/MF $0.50

A study was made of the contribution of core polarization to observed hyperfine fields, H_c, of 4d ions using the spin-polarized Hartree–Fock (SPHF) method. As a starting basis analytic restricted Hartree–Fock solutions obtained previously were used. Results obtained for the ^{6}S state ions Mo^{+}, Tc^{2+}, and Ru^{3+} and for Pd^{2+} and Pd^{3+}, show that H_c is large and negative and is due almost entirely to the negative 2s and 4s contributions; the small 3s contribution is positive. While the individual s-shell contributions vary with ion, H_c per spin is constant (to within 5%), unlike the much cruder constancy noted earlier for the 3d ions. Detailed comparisons are made with earlier results for the 3d ions. H_c per unpaired spin is found to be ~ -375 kG per unpaired spin, in very good agreement with experiments on Pd metal, e.g., from Knight shift measurements. Seitchik et al find that H_c per spin is -345×10 kG per unpaired spin. Author (NSA)

N66-31797# Hamburg Univ. (West Germany). Deutsche Elektronen-Synchrotron.
PHOTOPRODUCTION OF π MESONS, PART II [PHOTOERZEUGUNG VON π MESONEN, II: TEIL]

P. Stichel Feb. 1964 106 p refs In GERMAN; ENGLISH summary
(DESY-66/2)

Photoproduction of π mesons in the Bev-region is discussed. The foundation of the peripheral model and a detailed discussion of its application to photoproduction processes are included. NSA

N66-31799# Brookhaven National Lab., Upton, N. Y.
THE NEUTRON CROSS SECTION OF SODIUM BELOW 40 KeV
Thomas E. Stephenson [1964] 18 p refs Presented at the Am. Phys. Soc., Conf. of Neutron Cross Section Technol., Washington, D. C.
(Contract AT(30-2)-GEN-16)
(BNL-10085; CONF-660303-9) CFSTI: HC $1.00/MF $0.50

The neutron cross section of sodium from 1 ev to 40 kev is calculated. A good fit to the data is obtained whith the spin-dependent scattering radii R'_+=5.85 f and R'_-=5.18 f. A good fit is not found using a spin-independent scattering radiu. The excess absorption resonance integral is calculated to be 0.072 barns and is in good agreement with experimental values. The scattering resonance integral is calculated to be 72 barns which compares favorably with an evaluated experimental result. The low energy potential scattering is described by spin-dependent square potential wells. Author (NSA)

N66-31800# Brookhaven National Lab., Upton, N. Y.
DIFFERENTIAL AND INTEGRAL CROSS SECTIONS FOR THE TRANSURANIUM ELEMENTS
S. Pearlstein [1964] 16 p Presented at the Am. Phys. Soc., Conf. of Neutron Cross Section Technol., Washington, D. C.
(Contract AT(30-2)-GEN-16)
(BNL-10083; CONF-660303-8) CFSTI: HC $1.00/MF $0.50

Cross sections useful for determining the production of transuranium elements are evaluated using the Breit-Wigner single level formula. Thermal cross sections and resonance integrals for neutron capture and fission are presented for the ^{234}U, ^{236}U, ^{237}Np, ^{238}Pu, ^{240}Pu, ^{241}Pu, ^{242}Pu, ^{241}Am, ^{243}Am, and ^{244}Cm nuclides. Author (NSA)

N66-31827# Comitato Nazionale per l'Energia Nucleare, Frascati (Italy).
ESTIMATE OF THE RESIDUES OF THE MACHINE AT ADONE [STIMA DEI FONDI DI MACCHINA INTORNO AD ADONE]
M. Bernardini and S. Tazzari 15 Apr. 1966 14 p refs In ITALIAN *Its* Nota Interna No. 319
(LNF-66/22) CFSTI: HC $1.00/MF $0.50

Briefly discussed are elementary particles, elastic scattering, electron capture, photoproduction, and related topics. The interaction of electrons with residual gas is reported, and the following reactions are studied: (1) electrons and protons in the reaction $e + p \rightarrow e + p$; (2) electrons in the reaction $e + z \rightarrow z + e$; (3) electrons and γ in the reaction $e + z \rightarrow z + e + \gamma$; and (4) pion mesons in the reaction $e + z \rightarrow z' + e + \pi$. R.L.

N66-31830# Polish Academy of Sciences, Cracow. Inst. of Nuclear Physics.
THE MOESSBAUER EFFECT FOR THE IMPURITY ATOMS OF ^{57}Fe
Jozef Bara and Andrzej Z. Hrynkiewicz Feb. 1966 18 p refs
(Rept.-458/PL) CFSTI: HC $1.00/MF $0.50

The Debye-Waller factors for the 14.4 keV gamma rays of Fe 57 atoms as a dilute impurity in 16 crystal lattices were measured at room temperature. It was found that force constants for the host-impurity atoms are almost the same as for the host-host atoms. The correlation between the isomer shifts and the standard electrode potentials was observed. Author

N66-31836# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).
ON A CLASS OF COMPLETELY TRANSPARENT NON-LOCAL TWO-BODY POTENTIALS
K. Chadan Jun. 1966 26 p refs
(TH/154) CFSTI: HC $2.00/MF $0.50

The existence of a large class of non-local two-body potentials, which are completely transparent at all energies is shown. These potentials are superpositions of a local central potential and a sum of separable potentials. Starting from an arbitrary local potential, we show how to choose the non-local separable parts in such a way that the effects of the local potential are cancelled out at all energies and for all angular momenta. The total Hamiltonian therefore becomes equivalent to the free Hamiltonian as long as the S-matrix on the energy shell is concerned. At finite distances, the wave function is of course different from the free wave function, but the difference goes to zero in the limit of large distances. The transparent potentials we obtain are not pathological; they have acceptable singularities at the origin and vanish fast at infinity. In the example presented the potentials are less singular than r^{-1} at the origin, and decrease exponentially when $r \rightarrow \infty$. Author

N66-31845# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).
FADDEEV EQUATIONS AND RELATIONS BETWEEN RESONANCES
P. Dennery and A. Krzywicki Jun. 1966 23 p refs
CFSTI: HC $1.00/MF $0.50

A mathematical method for treating the Faddeev equation is represented. The Faddeev–Lovelace equations in the static limit are considered and brought to a tractable form by generalizing some methods that were elaborated to solve the Källen-Pauli equation. The method is sufficiently general so that one may hope to apply it in the relativistic case. The results are applied to a model which leads to recurrence relations among resonances. Author

N66-31866# Central Lab. for Radiological Protection, Warsaw (Poland).
ABSOLUTE METHOD OF THE GAMMA-RAY BACKGROUND DETERMINATION BY MEANS OF NaI(Tl) SCINTILLATION COUNTER [METODA BEZWZGLEDNEGO POMIARU TLA PROMIENIOWANIA GAMMA LICZNIKIEM SCYNTYLACYJNYM NaJ(Tl)]
J. Pensko 1966 26 p refs Submitted for Publication
(CLOR-46/D) CFSTI: HC $2.00/MF $0.50

This report presents the absolute method for the dose rate measurements of the gamma-ray natural background by means of the NaI(Tl) scintillation counter. The calibration factor was determined taking into account the angular response of the counter, energy response, the response of the counter to natural beta and cosmic radiation and the radioactive pollution of constructing materials. This method makes possible to determine the global gamma dose rate originating from natural and artificial—from nuclear explosions—background with the overall error not exceeding ±7.5 percent. The stability of the lower discrimination level (300 keV) was kept better than ±5 percent. Author

N66-31877# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.

CROSS SECTIONS FOR THE PRODUCTION OF THE ISOMERIC PAIR $Co^{58g, 58m}$ IN THE $Co^{59}(n,2n)Co^{58}$ REACTION FOR THE NEUTRON ENERGY RANGE 13.2–15.7 MeV

P. Decowski, W. Grochulski, A. Marcinkowski, K. Siwek, I. Sledzinska et al Dec. 1965 15 p refs Prepared in cooperation with Warsaw Univ.

(INR-668/I/PH) CFSTI: HC $1.00/MF $0.50

The cross-sections for the production of the isomeric pair $Co^{58m,g}$ in the $Co^{59}/n,2n/Co^{58}$ reaction for the neutron energy range 13.2–15.7 MeV were measured and the isomeric cross-sections ratios were obtained. Experimental results were compared with the theoretical predictions based on the model proposed by Vandenbosch and Huizenga. The parameter δ connected with spin dependence of the nuclear level density was estimated. Author

N66-31878# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.

THE CROSS-SECTIONS OF THE FISSION OF Pu^{239} BY NEUTRONS IN THE 13.1–15.4 MeV ENERGY RANGE [PRZEKROJE CZYNNE ROZSZCZEPIENIA Pu^{239} PRZEZ NEUTRONY O ENERGIACH OD 13.1 DO 15.4 MeV]

T. Czyzewski, P. Decowski, and B. Fryszczyn Feb. 1966 14 p refs Prepared in cooperation with Warsaw Univ.

(INR-688/I/PH) CFSTI: HC $1.00/MF $0.50

Neutron fission cross sections of Pu^{239} were measured in the 13.1 to 15.4 MeV energy range with relation to neutron fission cross section of U^{238} by means of mica detectors. Author

N66-31908# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.

ISOMERIC CROSS SECTION RATIOS FOR Ni^{58} (n,p) $Co^{58g,58m}$ REACTION INDUCED BY NEUTRONS IN THE 13.2–15.5 MeV ENERGY RANGE [STOSUNKI IZOMERYCZNE DLA REAKCJI $Ni^{58}(n,p)Co^{58g,58m}$ WYWOLANEJ NEUTRONAMI O ENERGIACH OD 13, 2–15,5 MeV]

S. Chojnacki, P. Decowski, E. Gierlik, W. Grochulski, A. Marcinkowski et al Dec. 1965 20 p refs

(INR-680/I/PH) CFSTI: HC $1.00/MF $0.50

The isomeric cross section ratios for the $Ni^{58}/n,p/Co^{58}$ reaction for the neutron energy range 13.2–15.5 MeV were measured. The total cross sections for $Ni^{58}/n,2n/Ni^{57}$ reaction were obtained independently. Experimental results were compared with the theoretical predictions based on the model proposed by Vandenbosch and Huizenga. The parameter σ connected with the spin dependence of the nuclear level density was estimated. Author

N66-31909# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).

FOUR PARTICLE CORRELATIONS IN LIGHT NUCLEI, II

B. Bremond Jun. 1966 26 p refs

(TH/153) CFSTI: HC $2.00/MF $0.50

The problem of two protons and two neutrons in an open shell with either pairing or contact interactions is studied. It is found that these interactions, which were equivalent for the two-neutron case, are no longer equivalent, the latter favouring four-particle correlations. The nucleus S^{32}, considered as formed of two clusters of four holes of the most general form, is then studied. Author

N66-31919# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.

X-RAY STUDIES OF NEUTRON BOMBARDMENT INFLUENCE ON THE REAL STRUCTURE OF GERMANIUM [BADANIE WPLYWU BOMBARDOWANIA NEUTRONAMI NA REALNA STRUKTURE GERMANU]

J. Auleytner, J. Krylow, M. Psoda (Warsaw Univ.), and S. Szarras Jan. 1966 18 p refs Submitted for Publication

(Rept.-684/II/PH) CFSTI: HC $1.00/MF $0.50

The dislocation distribution and density in as-grown and plastically deformed germanium single crystals before and after fast neutron bombardment (dose about $2 \cdot 10^{19}$ neutrons/cm^2) were studied. An X-ray spectrometer with oscillating film was used for measurements. No changes of dislocation density in as-grown specimens were observed after irradiation. In plastically deformed crystal changes of disorientation of mosaic blocks in the range of ± 1 min of arc and the increase of dislocation density within the blocks have been found. Author

N66-31956# Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati.

η PHOTOPRODUCTION CROSS SECTION FOR INCIDENT PHOTON ENERGIES 800 TO 1000 MeV

C. Bacci, C. Mencuccini, G. Penso, G. Salvini, and V. Silvastrini 20 Mar. 1966 34 p refs Submitted for Publication /*ts* Nota Interna No. 318

(LNF-66/20) CFSTI: HC $2.00/MF $0.50

Photoproduction cross-section of the η particle for incident photon energies K from $\sim$800 to $\sim$1000 MeV has been measured at the 1.1 GeV Frascati electronsynchrotron. The differential cross section for this process, at center of mass angle of the η of $\sim 110°$, turns out to be fairly constant for 830 MeV$\leq K \leq$ 900 MeV, and drops down of a factor 5 to 10 at K = 950 MeV. These results are discussed in terms of a comparison with the data on the production of η's by pions, and with the data on pion–nucleon scattering and pion photoproduction. The conclusions are in agreement with the hypothesis that the η-N system is dominated at low energies by a resonance with orbital angular momentum 1 = 0 ($S_{1/2,1/2}$ resonance). Author

N66-31964# Polish Academy of Sciences, Cracow. Inst. of Nuclear Physics.

COMPUTATION $\delta(\ell)$ ACCORDING TO THE STRONG ABSORPTION THEORY GIVEN BY FRAHN AND VENTER. THE PROGRAMMES FOR COMPUTER UMC-1 [OBLICZANIE $\delta(\ell)$ WEDLUG TEORII SILNEJ ABSORPCJI FRAHNA–VENTERA PROGRAMY DLA MASZYNY CYFROWEJ UMC-1]

Alicja Dudek 1966 77 p refs In POLISH; ENGLISH summary

(Rept.-446/PL) CFSTI: HC $2.50/MF $0.75

The program for computation of the differential cross-sections for elastic scattering of charged particles in the presence of strong absorption are presented according to the theory given by Frahn and Venter both with and without consideration of the volume absorption. Author

N66-31989# Osterreichische Studiengesellschaft für Atomenergie G.m.b.H., Seibersdorf. Institut fuer Strahlenschutz.

OPTIMUM CONDITIONS FOR MEASUREMENT OF RADIOACTIVE PREPARATIONS BY CONSIDERATION OF STATISTICAL ERRORS [OPTIMALE BEDINGUNGEN ZUR MESSUNG RADIOAKTIVER PRAPARATE BEI BERUCKSICHTIGUNG DES STATISTISCHEN FEHLERS]

Christo Kambourov [1966] 28 p refs In GERMAN Submitted for Publication
(SGAE-SS-4/1966) CFSTI: HC $2.00/MF $0.50

Statistical optimization procedures were employed to obtain the most accurate radioactive measuring conditions for nuclear sources. Differential equations were first used to find the absolute minimum for overall measuring intervals, and then to compare the measured null reference values with maximal effects. Transl. by G.G.

N66-31991# Polish Academy of Sciences, Cracow. Inst. of Nuclear Physics.
THE $^{40}Ca(d,d),(d,d')$ AND (d,p) REACTIONS AT DEUTERON ENERGY 12.8 MeV
H. Niewodniczanski, J. Nurzynski, A. Strzalkowski, and G. R. Satchler (Oak Ridge Natl. Lab.) Jan. 1966 25 p refs
(Rept.-442/PL) CFSTI: HC $1.00/MF $0.50

Differential cross-section measurements are presented for inelastic scattering of deuterons exciting three levels of Ca^{40} nucleus and also for the stripping reaction leading to the ground state and two excited states of the residual Ca^{41} nucleus. Measurements were obtained through use of a 12.8 MeV deuteron beam. A distorted wave model was used for theoretical analysis of the experimental data, with the deuteron distorting potential obtained from the optical model analysis of elastic scattering data. S.P.

N66-32002# Grumman Aircraft Engineering Corp., Bethpage, N. Y.
ON DETERMINING THE EQUATIONS OF LIQUIDUS AND SOLIDUS CURVES BY LEAST SQUARE TECHNIQUES WITH TERMINAL RESTRICTIONS
C. H. Li Jun. 1966 22 p ref
(RM-330)

Equations are presented for determining, by least square techniques, the constants for the second order equations representing the liquidus and solidus curves on the phase diagram. Three cases are treated with none, one, and two end restrictions. A test example is examined for all these cases using hand and single- or double-precision machine computations that carried 8 to 16 significant figures. Applying end restrictions distinctly improved the accuracy of the computed constants, particularly for the solidus curve and with the use of hand or single-precision machine computations. As a result, the standard errors of estimate on solute concentrations are reduced by 20 to 50 percent. It is therefore recommended that end restrictions—at least one but preferably two—should always be applied when determining these constants. The improvement introduced by end restrictions is much greater as the number of significant figures in the computations is reduced. Author

N66-32040*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
REARRANGEMENT COLLISIONS. III: ELECTRON TRANSFER FROM ATOMS TO FAST PROTONS
M. H. Mittleman *In its* Publ. of Goddard Space Flight Center, 1963, Vol. I [1963] p 1518–1525 refs Supported in part by AEC (See N66-32006 18-30) GPO: HC $9.75; CFSTI: MF $7.50

The high energy rearrangement collision, in which a fast proton incident upon an atom picks up an electron, is considered. It is found that with the present understanding of rearrangement collisions the cross section can be given for any atom in a restricted energy region with some theoretical uncertainty due to higher order collisions. Author

N66-32041*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE STRUCTURE OF ZINC OXIDE NUCLEI
R. Powell, B. Donn, and G. W. Sears (General Dynamics/Electronics) *In its* Publ. of Goddard Space Flight Center, 1963, Vol. I [1963] p 1570–1572 refs (See N66-32006 18-30) GPO: HC $9.75; CFSTI: MF $7.50
(Contract NAS5-1590)

An investigation into the structure of zinc oxide nuclei showed that zinc oxide fourlings originate in a single nucleation event. The experimental procedures used are outlined and it is stated that they should provide a general method of deducing the structure of a variety of nuclei. H.S.W.

N66-32042*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
RELATIVE PARTIAL WAVE THEORY OF DIATOMIC MOLECULES
A. Temkin *In its* Publ. of Goddard Space Flight Center, 1963, Vol. I [1963] p 1592–1600 refs (See N66-32006 18-30) GPO: HC $9.75; CFSTI: MF $7.50

The method of expanding the Hamiltonian in (relative) partial waves and introducing similarly expanded but truncated series as approximate solutions is utilized in the case of $(H_2)^+$ as a prototype of diatomic molecules. Thirteen states have been examined at four internuclear separations and results compared to exact results. In particular, oscillator strengths have been computed, and various properties of the approximate solutions are exhibited which make this method potentially very useful especially for some astrophysical applications. A simple modification of the theory can be made which ensures that the oscillator strengths satisfy the sum rules. Author

N66-32043*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
NONSEPARABLE THEORY OF ELECTRON-HYDROGEN SCATTERING
A. Temkin and D. E. Hoover *In its* Publ. of Goddard Space Flight Center, 1963, Vol. I [1963] p 1601–1604 refs (See N66-32006 18-30) GPO: HC $9.75; CFSTI: MF $7.50

The Schrodinger equation for the S-wave scattering of electrons from hydrogen is expressed completely in terms of partial differential equations, and by introducing the S-wave-function ψ, suitable boundary conditions were obtained. A detailed reduction of the S-wave equation is outlined, including the solution of the zeroth-order problem. The programming of this type of problem for computer solution is discussed. H.S.W.

N66-32096# Picatinny Arsenal, Dover, N. J. Engineering Sciences Lab.
A ONE-VELOCITY S_N COMPUTER CODE
R. Kesselman Jun. 1966 49 p refs
(PA-TR-3247; AD-633426) CFSTI: HC $2.00/MF $0.50

A set of calculations on the angular and spatial distribution of monoenergetic neutrons in a uniform slab was made using the S_N method. The basic S_N technique is explained in detail. A Fortran II computer code for the IBM 7090 for the distribution of monoenergetic neutrons in plane geometry using the S_N approximation is presented. Absorption and isotropic elastic scattering are taken into account. Calculations were conducted to study the effect on the neutron distribution of varying the space mesh size and the number of angular intervals. The results indicated that an S_8 approximation and a space mesh increment of ≥ 0.2

mean free path will give sufficiently good accuracy for calculation of the flux. Graphs and tables showing the variation of flux, inverse relaxation distance, and linear extrapolation distance with C (the ratio of the scattering to the total macroscopic cross sections) are presented. Author (TAB)

N66-32115*# Wisconsin Univ., Madison. Theoretical Chemistry Inst.

A PERTURBATION THEORY OF THE CONSTRAINED VARIATIONAL METHOD IN MOLECULAR QUANTUM MECHANICS

W. Byers Brown 8 Mar. 1965 34 p refs
(Grant NsG-275-62)
(NASA-CR-67830; WIS-TCI-83) CFSTI: HC $2.00/MF $0.50 CSCL 20J

The variational problem of minimizing the energy of a trial wave function which is constrained to give the known theoretical or experimental expectation value of an operator is discussed. A perturbation approach is developed which leads to simple equations for estimating the effect of the constraint on the expectation values of other operators, and the increase in energy due to the constraint. It is shown that for hypervirial operators the constraint procedure for satisfying the corresponding hypervirial theorem leads to equal and opposite results from the variational procedure. The theory is extended to cover the effect of constraints on second-order properties and multiple constraints. The perturbation equations are applied to Robinson's (1957) calculations on the lithium hydride molecule, previously discussed by Rasiel and Whitman (1964). Author

N66-32212# Joint Inst. for Lab. Astrophysics, Boulder, Colo.

THE CONVERGENCE OF THE SUPERPOSITION OF CONFIGURATIONS

Erling Holoien 22 Jun. 1966 20 p refs
(JILA-76)

The method of superposition of configurations (SOC) has been applied to the study of correlation effects in the helium ground state. The "radial" one-electron orbitals are in turn constructed from the orthonormal complete set of the associated Laguerre functions of order (2q+2) and degree (n-q-1) with single orbital exponent (optimized scale parameter). For the state all configurations to g-g are included, resulting in a 54-dimensional basic set. The convergence is sought as a function of q and found to be very slow toward the exact energy. The results are compared with those obtained by SOC calculations using nonorthogonalized basic functions. Author

N66-32221# North Carolina State Coll., Raleigh.

AN INVESTIGATION OF THE NUCLEAR REACTIONS $B^{10}(n,\alpha)Li^{7*}$, Li^7 BY THE USE OF SEMICONDUCTOR RADIATION DETECTORS

William Morgan Toney (M.S. Thesis) 1965 52 p refs
(Contract AF 33(608)-1092)
(AD-481447)

The purpose of this research was to investigate the $B^{10}(n,\alpha)Li^{7*}$, Li^7 reactions using semiconductor radiation detectors and to determine the energies involved, including the energy level of the excited state lithium. A method for determining the zero energy correction factor in measuring the energy of two different type particles with semiconductor detectors was developed. TAB

N66-32254*# Pittsburgh Univ., Pa. Space Research Coordination Center.

EXTENSIONS OF THE MOMENTUM TRANSFER THEOREM

E. Gerjuoy 28 Jan. 1966 15 p refs
(Grant NsG-416)
(NASA-CR-76651; SRCC-26) CFSTI: HC $1.00/MF $0.50 CSCL 20H

Lippmann recently discussed the extension of the momentum transfer theorem to systems more complicated than the elastic or inelastic collisions of electrons with atomic hydrogen and to other observables so as to derive, e.g., an energy transfer theorem. He took exception to some remarks concerning the validity of the symbolic methods customarily used in scattering theory. These remarks, which proved the momentum transfer theorem for e-H collisions, were accurately quoted, but did not appear in his paper because they were not wholly defensible. Nevertheless some differences remain between Lippmann's and this author's views of the status of the momentum transfer theorem and its extensions. This paper is presented to make these differences explicit. Author

N66-32315*# Grumman Aircraft Engineering Corp., Bethpage, N. Y.

CALCULATIONS OF THE INTERACTIONS OF DIATOMIC MOLECULES WITH SOLID SURFACES

R. A. Oman Jun. 1966 26 p refs Presented at 5th Intern. Symp. on Rarefied Gas Dyn., Oxford, 4-8 Jul. 1966
(Contract NASw-1195)
(NASA-CR-76724; RE-260J) CFSTI: HC $2.00/MF $0.50 CSCL 07D

Three dimensional classical interactions of homonuclear diatomic gas molecules with fcc solid surfaces are calculated by digital computer. The results are compared to matched monatomic interactions previously reported, and to a phenomenological model which gives algebraic expressions for the energy exchanges. Diatomic results indicate an important reduction in energy and tangential momentum transmitted to the lattice, but a slight increase in gas exit energy over the monatomic cases. Diatomic particles experience significantly less lateral scattering than do monatomic. Vibrational energy changes are small except at high energy, and rotational energy change varies linearly with incident translational energy. Author

N66-32324# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).

A REMARK ABOUT THE GENERAL METHODS IN CURRENT ALGEBRA

M. Gourdin Jun. 1966 10 p refs
(TH/156) CFSTI: HC $1.00/MF $0.50

Two general methods used in the framework of the algebra of currents from which the Adler-Weisberger sum rule follows are compared. The problem is restricted to the part of the skew symmetric amplitudes in the exchange of the unitary spin indices. A.G.O.

N66-32349# Argonne National Lab., Ill.

PHYSICS DIVISION SUMMARY REPORT, APRIL-DECEMBER 1965

Lowell M. Bollinger [1965] 118 p refs
(Contract W-31-109-ENG-38)
(ANL-7108) CFSTI: HC $4.00/MF $0.75

A compilation of progress reports in the areas of experimental nuclear physics; mass spectrometry; and general

theoretical physics is presented. These major areas include studies of the gamma ray spectra from capture in neutron resonances; pulsed beam experiments with the Van De Graaff machine; nuclear resonance absorption of gamma rays; scattering of charged particles; blocking effects in the emergence of charged particles from monocrystals; electron emission from metal monocrystals under high energy ion impact; mass spectrometer with a photoionization source; properties of light nuclei; and shell model calculations. C.T.C.

N66-32356# Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.

ENERGY SPECTRA OF NEUTRONS AND GAMMA RAYS FROM SPONTANEOUS FISSION OF ^{244}Cm

T. Richard Herold Jul. 1965 24 p refs

(Contract AT(07-2)-1)

(DP-949) CFSTI: HC $2.00/MF $0.50

The energy spectrum of the neutrons from the spontaneous fission of ^{244}Cm was measured from 0.5 to 6 Mev with a solid state ^{3}He spectrometer. The spectrum shows a maximum at about 0.75 Mev and decreases exponentially above 2 Mev. The energy spectrum of the gamma rays that were emitted within 180 nanoseconds of the spontaneous fission neutrons was measured from 0.1 to 2.5 Mev with a gamma ray spectrometer that included the ^{3}He spectrometer in a coincidence circuit. The gamma ray spectrum shows a dual-peak maximum at about 200 kev and decreases exponentially above 800 kev. Both measured spectra are similar to the corresponding spectra from the spontaneous fission of ^{252}Cf. The measurements were made with a purified sample of 95.5 wt % ^{244}Cm that was produced in a Savannah River reactor. Author (NSA)

N66-32381# Comitato Nazionale per l'Energia Nucleare, Frascati (Italy).

ASYMMETRY RATIOS IN THE PHOTOPRODUCTION OF π^+ BY LINEARLY POLARIZED γ RAYS IN THE ENERGY RANGE 200–400 MeV

M. Nigro, E. Schiavuta (Padua Univ.), P. Gorenstein, M. Grilli, F. Soso et al 13 Apr. 1966 11 p refs *Its* Nota Interna No. 320

(LNF-66/23) CFSTI: HC $1.00/MF $0.50

Within the framework of the reaction $\gamma+p=n+\pi^+$, near the first resonance, measurements were made of the asymmetry ratio A(90°) in the energy interval E=200–400 MeV. A table which summarizes the results obtained is included, and these results are compared to previous theoretical predictions. H.S.W.

N66-32405# Columbia Univ., New York. Dept. of Physics.

PEGRAM NUCLEAR PHYSICS LABORATORIES Progress Report, Jan. 1964–Jan. 1965

Oak Ridge, Tenn., AEC, Feb. 1966 165 p

(Contract AT (30-1)-GEN-72)

(NYO-72-28) CFSTI: HC $5.00/MF $1.00

Various experimental and theoretical studies were made in the areas of neutron physics, nuclear reactions with charged particles, beta and gamma spectroscopy and application to nuclear structure, neutron interactions with condensed matter, macroscopic neutron physics, and instrument development. NSA

N66-32448# Los Alamos Scientific Lab., N. Mex.

COMPUTATION OF ELECTROSTATIC AND RAPIDLY PULSED MAGNETIC FIELDS

K. R. Crandall and H. R. Lewis 18 Apr. 1966 103 p refs

(Contract W-7405-ENG-36)

(LA-3416) CFSTI: HC $4.00/MF $0.75

It is often required, for example, in the design of some pulsed controlled-thermonuclear-fusion experiments, to calculate electrostatic fields and to calculate magnetic fields in the approximation that flux does not penetrate metal boundaries of the experimental volume. Computation of such magnetic and electric fields by means of the standard relaxation methods is often difficult and very costly, even with high-speed computers. This is because the boundaries of the region of experimental interest are rather arbitrary, and because there are generally current- or charge-carrying conductors within the region that make it nonsimply-connected. An alternative method of solving the boundary-value problems that determine these electric and magnetic fields, which does not involve a difference approximation to the differential equations, was developed. With this method, an exact analytic solution of the appropriate differential equation is obtained in the region of interest, and this solution is made to approximate the boundary conditions. The method and its application are described in detail. Examples of the application of the method to some controlled-thermonuclear-fusion experiments are given. Author (NSA)

N66-32454# California Univ., Berkeley. Lawrence Radiation Lab.

A MEASUREMENT OF THE ANOMALOUS GYROMAGNETIC RATIO OF THE MUON

G. Schrank, G. R. Henry, and R. Swanson 28 Oct. 1965 126 p refs

(Contract W-7405-ENG-48)

(UCRL-16469) CFSTI: HC $6.00/MF $0.75

A measurement of (g-2) for the free, positive muon was made. The value obtained was $(g-2)_{\mu}=2(0.00106\pm0.000067)$ and is to be compared with the theoretical value of 2(0.0011654). The technique consisted of trapping polarized muons, one at a time, in an essentially homogeneous, 28-kG magnetic field for about eight muon lifetimes. While in this field, the muon undergoes cyclotron motion (ω_c) and its magnetic dipole moment also processes (ω_p) about the magnetic field vector. The difference frequency ($\omega_c-\omega_p$) was measured and this quantity, in appropriate units, is $(g-2)_{\mu}$. Author (NSA)

N66-32460# California Univ., Livermore. Lawrence Radiation Lab.

PHYSICS DEPARTMENT Progress Report, Jun.–Sep. 1965

[1966] 82 p refs

(Contract W-7405-ENG-48)

(UCRL-14538) CFSTI: HC $3.00/MF $0.75

Various experimental and theoretical research carried out in the field of atomic and nuclear physics, thermodynamic properties of matter, fluid and hydrodynamics, and radiation physics is reported. Brief summaries of research on each of the above are presented. NSA

N66-32463# California Univ., Livermore. Lawrence Radiation Lab.

THEORETICAL DIFFERENTIAL SCATTERING CROSS SECTIONS OF X-RAYS FOR H, He, Li, Li^+, Be, B, C, AND C IN THE VALENCE STATE

R. J. Stinner, W. H. Mc Master, and N. Kerr Del Grande 23 Sep. 1965 147 p refs

(Contract W-7405-ENG-48)

(UCRL-14403) CFSTI: HC $4.00/MF $1.00

Theoretical differential scattering cross sections of X-rays were calculated for the following light elements: H, He, Li, Li^+, Be, B, C, and C in the valence state. These cross sections are given from 1 to 50 keV in keV steps and at scattering angle intervals of 15° over a 180° range; the cross sections are presented in both graphic and tabular form. Cross section calculations were made with the Thomson and Klein–Nishina cross section equations modified to account for electron binding. Author (NSA)

N66-32478# Oak Ridge National Lab., Tenn. Neutron Physics Div.
ELASTIC AND INELASTIC SCATTERING OF 12.7-MeV PROTONS FROM ^{90}Zr, ^{92}Zr, AND ^{94}Zr: TABULATED DIFFERENTIAL CROSS SECTIONS
J. K. Dickens, E. Eichler, R. J. Silva, and G. Chilosi May 1966 37 p refs
(Contract W-7405-ENG-26)
(ORNL-3934) CFSTI: HC $2.00/MF $0.50

Numerical values of differential cross sections for elastic and inelastic scattering of 12.7-Mev protons from Zr^{90}, Zr^{92}, and Zr^{94} are reported in tabular form. Cross sections were determined at 5° intervals between laboratory angles of 20 and 165°. Inelastic-scattering data are reported for twenty excited states of Zr^{90} (Q = −1.75, −2.18, −2.32, −2.74, −3.09, −3.31, −3.45, −3.63, −3.84, −3.97, −4.07, −4.12, −4.23, −4.33, −4.50, −4.57, −4.70, −4.82, −5.02, and −5.13 Mev); for twelve excited states of Zr^{92} (Q = −0.93, −1.37, −1.50, −1.85, −2.07, −2.19, −2.35, −2.50, −2.76, −3.08, −3.28, and −3.49 Mev); and for eleven excited states of Zr^{94} (Q = −0.916, −1.30, −1.47, −1.66, −2.06, −2.32, −2.36, −2.62, −3.16, −3.24, and −3.92 Mev). Author (NSA)

N66-32485# Phillips Petroleum Co., Idaho Falls, Idaho.
THE FISSION CROSS SECTION OF Pu-241 FROM 20–200 eV AS DETERMINED FROM A NUCLEAR EXPLOSION
O. D. Simpson, R. G. Fluharty, M. S. Moore, N. H. Marshall, B. C. Diven (Los Alamos Sci. Lab.) et al Apr. 1966 30 p refs
(Contract AT(10-1)-205)
(IDO-17174) CFSTI: HC $1.00/MF $0.50

A nuclear explosion was used as a neutron source for a measurement of the neutron-induced fission cross section of ^{241}Pu. Over the region from 20 to 200 ev, the region of thermal neutron energies of the source, the flux was high enough to permit the determination of fission cross sections with a minimal error. A comparison of these data with previous measurements of the fission cross section of ^{241}Pu shows that a significant improvement was made, both in resolution and in statistical accuracy. The data below 60 ev were analyzed with the use of a multilevel formula.
Author (NSA)

N66-32501# Uppsala Univ. (Sweden). Quantum Chemistry Group.
SECOND QUANTIZATION OF AN ARBITRARY OPERATOR Scientific Report No. 52
Donald H. Kobe 1 Oct. 1965 11 p refs
(Contract AF 61(052)-701)
(ARL-0085; AD-633056) CFSTI: HC $1.00/MF $0.50

The representation of an arbitrary operator in second quantization is obtained for both fermion and boson systems by using the isomorphism between second quantization and a graded configuration space. Author (TAB)

N66-32502# Illinois Univ., Urbana. Dept. of Physics.
MOSSBAUER SCATTERING IN Pt^{195} I
M. Atac, P. Debrunner, and H. Frauenfelder [1965] 15 p refs
(Contract Nonr-1834(05))
(AD-632579) CFSTI: HC $1.00/MF $0.50

The Mossbauer effect of the 99 keV transition in Pt^{195} was studied in a backscattering geometry. From the partially resolved Zeeman pattern observed with platinum in iron, cobalt and nickel, the g-factor of the excited state, $g_{3/2} = -0.43 \pm 0.10$, and the internal fields were determined. Author (TAB)

N66-32522# California Univ., Berkeley. Lawrence Radiation Lab.
PRODUCTION PROPERTIES AND DECAY MODES OF THE ϕ MESON
James Seward Lindsey (Ph.D. Thesis) 21 Dec. 1965 74 p refs
(Contract W-7405-ENG-48)
(UCRL-16526) CFSTI: HC $3.00/MF $0.75

The reaction $K^-p \rightarrow \Lambda\phi$ was studied in an exposure of the LRL 72-inch bubble chamber to a separated beam of K^- mesons of 2.1 to 2.7 BeV/c momentum. The decay branching ratios for K^+K^-, $K_1^0K_2^0$, $\rho\pi$, $\pi\gamma$, $\pi^+\pi^-$, $\rho\gamma$, and $\omega\gamma$ were measured, and the ratio $\beta = [\Gamma(\phi \rightarrow K_1^0K_2^0)/\Gamma(\phi \rightarrow K^+K^-)]$ was used as a test of the ϕ's spin. The quantum numbers assigned to the ϕ, $J^{PG} = 1^{2-}$ and $I = 0$, were verified. An attempt was made to fit decay-angular distributions to several models, in order to further confirm the spin 1 assignment for the ϕ. However, the distributions are consistent with predictions for both spin 1 and spin 3, so that no independent test of spin is possible. Production processes were investigated with the correlation-matrix method of Berman and Oakes. The low-momentum (2.1 BeV/c beam momentum) data fit a model of K and K^* exchange, but the high-momentum (2.45 to 2.7 BeV/c) data are inconsistent with the model. Also, other final states involving KK pairs were investigated, and their cross sections measured, but except for the production of the reaction $K^-p \rightarrow Y_1^*(1385)\phi$, no previously unreported effects were observed. Author (NSA)

N66-32530# Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro.
ON THE POLES OF THE S-MATRIX FOR LONG RANGE POTENTIALS
Erasmo M. Ferreira and Antonio F. F. Teixeira 1965 44 p refs *Its* Vol. II, No. 15
CFSTI: HC $2.00/MF $0.50

The analytic properties in the complex k-plane of the S-matrix for scattering by a screened Coulomb potential are studied. Particular attention is given to the limit as the screening radius tends to infinity, so as to show in an explicit example the effect of the tail of the potential on the properties of the analytically extended S-matrix. It is shown that the pole configuration obtained in this way is different from that obtained in the usual description of the analytic properties of the Coulomb S-matrix. Author

N66-32560# Aktiebolaget Atomenergi, Stockholm (Sweden).
INTEGRAL TRANSPORT THEORY IN ONE-DIMENSIONAL GEOMETRIES
Ingvar Carlvik Jun. 1966 70 p refs
(AE-227) CFSTI: HC $2.50/MF $0.75

A method called DIT (discrete integral transport) has been developed for the numerical solution of the transport equation in one-dimensional systems. The characteristic features of the method are Gaussian integration over the coordinate as described by Kobayashi and Nishihara, and

a particular scheme for the calculation of matrix elements in annular and spherical geometry that has been used for collision probabilities in earlier Flurig programs. The paper gives a general theory including such things as anisotropic scattering and multi-pole fluxes, and it gives a brief description of the Flurig scheme. Annular geometry is treated in some detail, and corresponding formulae are given for spherical and plane geometry. Author

N66-32587# Chicago Univ., Ill. Enrico Fermi Inst. for Nuclear Studies.

A STUDY OF EXTENSIVE AIR SHOWERS

V. I. Yakovlev [1965] 27 p refs Presented at the Astrophys. Seminary, Chicago, Jun. 1965

The phenomenon of extensive air showers (EAS) is studied and the different methods used for the registration and analysis of every EAS component are described. The size spectrum of the EAS is obtained from measurements of the frequency of showers with a certain number of electrons. This spectrum is taken as a basis for constructing the primary energy spectrum which is shown schematically. The role played by nuclear-active particles, mainly nucleons and charged pions, in EAS is discussed and measurements show that dissipation of energy between a number of particles takes place. The composition of the high energy primary cosmic radiation is analyzed and an ionization calorimeter for studying the nuclear active component and central part of showers is described. An underground laboratory for studying muons and the use of Cerenkov detectors for primary particle atomic weight data are also mentioned. A.O.

N66-32632*# Oak Ridge National Lab., Tenn. Neutron Physics Div.

EFFICIENCY OF ORGANIC SCINTILLATORS FOR FAST NEUTRONS

R. J. Schuttler Jul. 1966 67 p refs

(NASA Order R-104; Contract W-7405-ENG-26)

(NASA-CR-76968; ORNL-3888) CFSTI: HC $2.50/MF $0.75 CSLC 18D

Organic scintillator detection efficiencies are estimated for incident neutrons above 12 MeV, in which region nonelastic reactions in the carbon of the detector become significant. The efficiency is given in a first effective collision approximation, later corrected for second-collision effects, as a function of a detector threshold on the fast component of the light from the phosphor. The analysis includes consideration of nonlinear light production of both fast- and slow-light components, pulse-shape discrimination against gamma rays, the detector's pulse-height resolution, and edge effects. For 14.5-MeV incident neutrons onto NE-213 detectors 2.61 and 6.1 cm thick, the method yields efficiencies of 9.7 and 21.7% for a fast-light threshold equivalent to pulses from 200-keV electrons, if no pulse-shape discrimination against gamma rays is employed. Author

N66-32636*# Massachusetts Inst. of Tech., Cambridge. Dept. of Physics.

VIBRATIONAL RELAXATION MEASUREMENTS IN CO_2 USING AN INDUCED FLUORESCENCE TECHNIQUE

L. O. Hocker, M. A. Kovacs, C. K. Rhodes, G. W. Flynn, and A Javan [1966] 17 p refs

(Grant NsG-330)

(NASA-CR-76951) CFSTI: HC $1.00/MF $0.50 CSCL 07D

A summary of preliminary experimental studies of a number of relaxation processes involving excited vibrational levels of the CO_2 molecule is presented. These studies involve the use of a new technique in which infrared fluorescence induced by the application of intense pulses of Q-switched 10.6μ laser radiation is used to obtain an accurate measure of the rate of volume quenching of the first excited asymmetrical stretching mode, of the CO_2 molecule. We have also shown that a number of widely spaced vibrational levels of this molecule are highly coupled through collisions; and because of this, the energy stored in these levels is coupled to the C.W. power output of the 10.6μ laser oscillation. The 10.6μ oscillation occurs on a transition involving only one pair of these collisionally coupled vibrational levels. The time constant involved in this collisional coupling is such that for a few microseconds after application of Q-switched radiation, an inversion of population may be obtained among these vibrational levels. This has enabled attainment of a new Q-switched laser oscillation at 4.3μ. Author

25 PHYSICS, PLASMA

Includes magnetohydrodynamics. For applications see: 28 Propulsion Systems.

N66-31638# Lockheed Missiles and Space Co., Sunnyvale, Calif.

NONLINEAR EFFECTS IN A PLASMA WAVEGUIDE. ION CYCLOTRON RESONANCE AT THE DIFFERENCE FREQUENCY

B. I. Ivanov [1965] 9 p refs Transl. into ENGLISH of the publ. "Vysokochastotnye Svoistva Plazmy" Kiev, Naukova Dumka, 1965 p 178-185

CFSTI: HC $1.00/MF $0.50

The dispersion relationship for ion cyclotron waves was investigated experimentally by excitation of low frequency oscillations in a plasma beam system. Low power generators were used to disturb a hydrogen plasma and to obtain nonlinear high frequency oscillations, followed by subsequent pumping of the energy from high to low frequency oscillations. A sensitive balance high-frequency bridge circuit connected to an oscilloscope through low-frequency filters was employed to observe the obtained weak ICR signals. Modulation of the magnetic field induced a bridge unbalancing signal. Measurements of the reflection coefficients from the end of the waveguide, magnetic field intensity, phase velocity, and plasma density established the following facts: The amplitude of the "difference" wave increased at the time of passing through resonance, and resonance frequency increased as magnetic field intensity grew but decreased with growing plasma density. G.G.

N66-31706# Stichting voor Fundamenteel Onderzdek der Materie, Jutphaas (Netherlands). Instituut voor Plasma-Fysica.

INVESTIGATION OF A LOW-PRESSURE PENNING DISCHARGE

W. Schuurman Mar. 1966 98 p refs

(NP-15954)

A Penning discharge is a gas discharge in a chamber formed by a cylindrical anode and two cathode plates opposite to each other, immersed in an axial magnetic field. A number of aspects of the Penning discharge are analyzed for one type of geometry (long anode cylinder) and for low pressure ($p < 10^{-4}$ torr). The motion of electrons in crossed

electric and magnetic fields was analyzed. Formulas, derived by previous authors, for the first Townsend coefficient α and for the systematic velocity v_E parallel to the electric field E are based upon unrealistic assumptions. It is investigated how α and v_E will change if these simplifying assumptions are not made. The breakdown characteristics are considered. The existing theory for a cylindrical magnetron discharge is applied to the Penning discharge. Next, the various discharge modes are analyzed. It starts with a classification and a short description of modes, followed by an expose of the different types of discharge characteristics to be found when gas pressure, anode voltage and magnetic field strength are varied. Extensive treatments are given of the most important modes at low pressure, one at low magnetic field (LMF), the other at high magnetic field (HMF). After a survey of experimental data concerning the LMF-mode, a theory is given, based on Poisson's equation and the continuity equation for electrons. The latter equation is provided with expressions for the kinetic parameters of the electrons, α and ν_i. Incidentally, a formal evaluation of current-voltage characteristics is sketched, in which α and ν_i are still arbitrary. The limits of this mode, viz the extinction at low magnetic field and the transition to the HMF-mode, are described and calculated. The HMP-mode is dealt with in an analogous way. Unfortunately, instabilities seriously limit the validity of a theoretical model based on stable operation of the discharge. The diocotron or slipping stream instability is effective in the whole existence region of the discharge. Nevertheless, some useful results can be obtained with the theory. The basic equations for the anode sheath and the structure of this sheath are investigated. A formula is derived for the ion density in the sheath. This formula predicts values in good agreement with experimental data. Although at very low pressure the ion density may be neglected it plays a dominant part in the transition to the high-pressure mode. The experimental data are presented. NSA

N66-31789# Nagoya Univ. (Japan). Inst. of Plasma Physics.
STABILITY OF A UNIFORM PLASMA COMPOSED OF STREAMS IN THE ABSENCE OF AN EXTERNAL FIELD
Hiromu Momota Feb. 1966 22 p refs Submitted for Publication
(IPPJ-45)

By means of the collisionless Boltzmann equation and the Maxwell equations with no external field, it is shown that a plasma composed of streams is necessarily unstable for a transverse oscillation propagating perpendicularly to the streams. The instability is attributed to the bunching of the electric current density, corresponding to the bunching of the charge density in the usual two-stream instability which is accompanied by the excitation of a longitudinal oscillation. When the thermal motion of the particles in a stream is taken into account, the instability can be suppressed due to the thermal diffisuion of the bunched current. For a transverse oscillation, a criterion of the stability is obtained.
Author (NSA)

N66-31962# Polish Academy of Sciences, Warsaw.
ELECTRICAL PARAMETERS OF THE DC MHD GENERATOR WITH VARIOUS ELECTRICAL CONNECTIONS OF ELECTRODES, VOLUME II [PARAMETRY ELEKTRYCZNE GENERATORA MAGNETOHYDRODYNAMICZNEGO PRZY ROZNYCH ELEKTRYCZNYCH POLACZENIACH ELEKTROD. CZESC II: ANALIZA DWUWYMIAROWA]
Zdzislaw N. Celinsui May 1965 210 p refs In POLISH; ENGLISH summary
(INR-654/XVIII/PP) CFSTI: HC $3.75/MF $1.25

Electrical parameters in the DC MHD generator with arbitrary connected electrodes were investigated. Constant gasdynamic parameters and constant generator cross-section were assumed. A vector diagram technique is developed to investigate the electrical parameters in the MHD generator. Electrical equivalent circuits were found and terminal values of electrical parameters (current, voltage, power, internal resistance) were determined. The numerical method of the two-dimensional analysis of the MHD generator with arbitrary electrode connections was developed. A correction factor λ was calculated, the use of which makes it possible to correct one-dimensional theory equations for two-dimensional effects. Author

N66-31983# Deutsche Versuchsanstalt für Luft- und Raumfahrt, Stuttgart (West Germany). Institut fuer Plasmadynamik.
EXPERIMENTAL INVESTIGATIONS ON ELECTRIC ARC PHENOMENA IN A RAPIDLY EXPANDING PLASMA FLOW [EXPERIMENTELLE UNTERSUCHUNGEN UEBER LICHTBOGENVORGAENGE IN EINER RASCH EXPANDIERENDEN PLASMASTROEMUNG]
Helmut Huegel Apr. 1966 50 p refs In GERMAN; ENGLISH summary
(DLR-FB-66-30; DYL-502) CFSTI: HC $2.00/MF $0.50

The specific impulse of electro-thermal thrustors is limited to about 1500 s. Additional thrust-producing mechanisms have to be applied in order to increase the exhaust velocities. They concern electro-magnetic forces which result from the interaction of arc current and magnetic fields. A device designed for the study of these effects is discussed. The experiments carried out so far concern mainly its operational condition. Current-voltage characteristics, pressure and pressure ratios, energy losses and thrust as functions of arc current (up to 1000 A) and mass flow rate (Ar) are discussed. A brief outlook shows the aims at which further work is directed. Author

N66-31996# Institut Franco-Allemand de Recherches, St. Louis (France).
HYPERFREQUENCY DIAGNOSIS OF PLASMA SHOCK WAVES [DIAGNOSTIC HYPERFREQUENCE DES PLASMAS DE CHOC]
13 Jul. 1965 22 p refs In FRENCH; GERMAN summary
(ISL-T-21/65) CFSTI: HC $1.00/MF $0.50

Experimental results of the expansion of millimeter waves in shock plasmas are presented. The investigations centered on the plasma-dependent phase shift. The resulting values permit calculation of the shock number and angular frequency of the plasmas that were investigated. Experimental and theoretical values were found to be in agreement.
Transl. by K.W.

N66-32129*# Yale Univ., Observatory, New Haven, Conn.
RELATIVISTIC BREMSSTRAHLUNG IN A PLASMA
S. P. S. Anand [1965] 32 p refs
(Grant NsG-176)
(NASA-CR-76633) CFSTI: HC $2.00/MF $0.50 CSCL 20I

The problem of a test particle moving through a plasma, causing in the process the emission of radiation by the plasma electrons, is treated for relativistic conditions. Expressions for longitudinal and transverse electric field components as well as for the radiation spectrum are derived. It is found that relativistic effects are only quantitative in nature and do not alter the general behavior of the spectrum. In particular, no new resonances are found. If the plasma ensemble is non-relativistic and interacts with a single relativistic test particle, the location of the resonance is the same as in the case of a non-relativistic test particle. Author

N66-32146# Elcon Lab., Inc., Peabody, Mass.
HIGH POWER MAGNETICALLY CONFINED PLASMA DUPLEXER Final Report, 31 May 1963–31 Aug. 1965
Edwin Langberg and William R. Ghen [1965] 239 p refs *Its* Rept.-9
(Contract DA-36-039-AMC-02364(E); ARPA Order 426; Proj. Defender)
(R-3-66-1; ECOM-02364-F; AD-632344) CFSTI: HC $6.00/MF $1.25

The theory of confining a microwave gas plasma discharge by means of a magnetic field is presented. Two types of magnetic fields, cusp shaped and mirror are analyzed. Both type fields are investigated experimentally using suitable microwave cavity structures and plasma containers. The high power experimental microwave equipment uses a traveling wave resonant ring simulator to ionize the plasma at pulsed powers up to 70 megawatts peak, 70 kilowatts average. The major technical problem associated with the use of a stable confinement system is the inherently long recovery time. The use of both chlorine as an attaching gas and a quartz wool filled plasma container reduces recovery time to practical ranges, but conflicts somewhat with the fundamental principles of confinement. The use of a quartz wool filled plasma container with cusp magnetic field seems to provide the best compromise between magnetic confinement principles and microwave performance. Author (TAB)

N66-32225# Michigan Univ., Ann Arbor. Dept. of Nuclear Engineering.
SCATTERING OF LIGHT FROM ATOMS, MOLECULES AND FREE ELECTRONS IN GASES AND PLASMAS
Carl M. Penney (Ph.D. Thesis) Oct. 1965 187 p refs *Its* Rept.-07599-1-T
(Contract DA-31-124-ARO(D)-403; Proj. Defender)
(AROD-6092-3; AD-633072) CFSTI: HC $5.00/MF $1.00

In this dissertation some basic relationships concerning the scattering of light from particles which are very small compared to wavelengths of interest—specifically free electrons, ions, atoms and simple molecules—are examined from a consistent application of quantum perturbation theory to a many body system. Of major concern are particles in gaseous or plasma systems, although many of the results may have broader validity. For the most part attention is confined to nonresonance, linear, single scattering. Higher ordered corrections to the scattering cross section which arise from the variation of the refractive index from unity are neglected and the possible effects of variations in the intensity of incident radiation over distances comparable to wavelengths of interest are not considered in detail. The results obtained under these conditions appear to retain wide limits of applicability which are discussed. However, where necessary, all of these conditions can be relaxed to varying degrees through procedures which are mentioned. Among the major results obtained are, first, a consistent and informative derivation of the dependence of light scattering in gases on particle-particle interactions; second, a comparatively simple derivation of the angular distribution of the scattered light; third, detailed relationships between scattering cross sections and oscillator strengths which permit the calculation of Rayleigh and Raman scattering cross sections under appropriate conditions; and fourth, a relationship between familiar quantum expressions for scattering cross sections and refractive indices which is significantly different than the well known classical relationship under conditions for which the classical relationship is often assumed to be valid.
Author (TAB)

N66-32303*# Yale Univ. Observatory, New Haven, Conn.
PLASMA RESONANCE RADIATION
Martin D. Altschuler [1965] 32 p refs
(Grant NsG-176)
(NASA-CR-76663) CFSTI: HC $2.00/MF $0.50 CSCL 20I

The spectral characteristics of electromagnetic radiation in the neighborhood of the plasma frequency are derived. The linearized hydromagnetic equations are used to find the self-consistent electric field of a test particle in the plasma. From this electric field the acceleration of an electron and the radiation emitted in this process are determined for a single encounter electron–test particle. The spectrum of the radiation emitted by the electrons surrounding the test particle is found by integrating the emission spectrum of a single encounter over a suitable range of impact parameters. When the relative speed of the test particle is less than the thermal speed of the plasma electrons, the spectrum agrees with calculations based on a spherical Debye potential for the test particle. For a test particle speed greater than the thermal electron speed a resonance arises near the electron plasma frequency. The energy emitted at this resonance is calculated and is found to increase with the test particle speed, whereas the energy emitted in the neighboring continuum decreases.
Author

N66-32304*# Yale Univ. Observatory, New Haven, Conn.
PLASMA RESONANCE RADIATION AND TYPE III BURSTS
Ludwig Oster [1966] 18 p refs
(Grant NsG-176)
(NASA-CR-76661) CFSTI: HC $1.00/MF $0.50 CSCL 20I

Altschuler's hydrodynamic theory of plasma resonance radiation induced by single test particles is extended to particle ensembles. It is shown that his expressions agree with the known results of kinetic theory in the case of thermal equilibrium. Next, the situation of a high temperature plasma permeated by fast particle clouds is considered, spectrum and total power emitted are calculated, and the results compared with type III bursts. It is found that the observed values can be represented by assuming a total of 10^{32} cloud particles in units of 10^{7} particles, with each cloud occupying about 10^{3} cm^{3}. The number of fast particles in the source area is thus less than 10^{-4} of the coronal electron density. Author

N66-32306# Toronto Univ. (Ontario). Inst. for Aerospace Studies.
THEORY OF SPHERICAL AND CYLINDRICAL LANGMUIR PROBES IN A COLLISIONLESS, MAXWELLIAN PLASMA AT REST
James G. Laframboise Jun. 1966 211 p refs
(Grants AF-AFOSR-366-63; AF-AFOSR-366-64; AF-AFOSR-366-65)
(UTIAS-100; AD-634596) CFSTI: HC $6.00/MF $1.25

A method was developed and used to obtain theoretical predictions of the current collected from a collisionless, fully Maxwellian plasma at rest by an electrically conducting Langmuir probe having spherical or cylindrical symmetry. The probe characteristic, or functional relation between current and probe potential, was determined for both geometries for probe radii up to 100 times the Debye shielding distance of the hotter species of charged particle, for a complete range of ion-to-electron temperature ratios and for probe potentials from −25 to +25 times the thermal energy of the hotter species. Each current collection result is computed to a relative accuracy of 0.002 or better in an average time of approximately two minutes on the IBM 7094. Explicit comparison is made between the results for a completely Maxwellian plasma and those for a plasma mono-energetic in

attracted particles, as treated by Bernstein and Rabinowitz, Lam, and Chen. It is shown that in certain cases, the monoenergetic plasma does not adequately simulate the Maxwellian plasma TAB

N66-32422# Columbia Univ., New York. Plasma Lab.
COLLECTIVE FLUCTUATIONS IN A LABORATORY MAGNETOPLASMA PERTURBED BY AN ELECTRON BEAM
Robert F. Leheny 1966 198 p refs
(Grant NSF GK-125)
(Rept.-29)

A study of the interaction between transverse electromagnetic waves and magnetoplasma to determine the state of the electron component of the plasma is described in this research. The induced emission of radiation by collective fluctuations in the electron component of the plasma, resulting from scattering of transverse waves, is investigated in a quiescent laboratory magnetoplasma perturbed by an electron beam. This combination scattering provides information on the intensity and spectra of the longitudinal waves propagating in the gas. By means of a resonance in the scattering, which occurs when the incident or scattered transverse wave is in resonance with the plasma electrons, extremely small amplitude fluctuations have been detected. The deviation from equilibrium resulting from weak perturbations in the form of an electron beam has been studied using this technique. The spectrum of fluctuations for sufficiently weak perturbations represents broad band excitation of longitudinal waves, with the amplitude of the waves limited by the finite energy of the beam. The transition from this type of excitation to the more usual strong oscillations, at well defined frequencies, is found to occur as electron beam intensity increases. Measurements of magnetobremsstrahlung in the absence of perturbations compares well with the level for emission from an equilibrium plasma, and established the equilibrium state of the electrons. Low frequency fluctuations, detected by Langmuir probes, have also been observed to be excited by electron beams. Author

N66-32479# Oak Ridge National Lab., Tenn. Thermonuclear Div.
PRELIMINARY REPORT ON BALL LIGHTNING
J. Rand Mc Nally, Jr. May 1966 22 p refs
(Contract W-7405-ENG-26)
(ORNL-3938) CFSTI: HC $2.00/MF $0.50

An extension of remarks made in a 1960 paper is presented. Though out of date in several respects (e.g., the possible roles of active nitrogen and of self-binding plasma forces, etc.) and perhaps erroneous in others, the original unpublished report is still being requested by individual scientists and reference agencies. The report, with minor changes, is now (March, 1966) being placed in official documentation channels to make it more readily available to interested sources. The following abstract accompanied the oral paper: "Ball lightning is a possible stable plasma configuration and hence may merit some consideration in the field of thermonuclear research. A survey of 15,923 Union Carbide Nuclear Company personnel in Oak Ridge was made with 498 reports of unusual lightning phenomena which the observers thought may have been related to ball lightning. Some of the results of the survey are presented." Author (NSA)

N66-32537# Hughes Aircraft Co., Culver City, Calif. Space Systems Div.
MAGNETOHYDRODYNAMIC CHANNEL FLOW
Richard R. Gold Jan. 1966 116 p refs /ts Rept.-4
(SSD-50158R)

Essential mathematical and physical aspects of laminar channel flow of an incompressible, viscous, electrically conducting fluid with a transverse electromagnetic field are reviewed along with existing solutions and quantitative information. The different geometries and boundary conditions that have been treated are examined, and the significant effects are discussed. Applications, such as electromagnetic flowmeters, pumps, and generators, are mentioned. Magnetogasdynamic equations are reviewed, and the essential features of both electromagnetic and gasdynamic theories are examined. General equations of the fully developed channel flow problem are formulated, and a detailed analysis of the generalized Hartmann flow between two infinite parallel plates is presented. The more realistic channel geometry with finite cross section is then considered, and available quantitative results, effects and trends of interest, problems, and applications are summarized. Entry of the flow into the magnetic field and into the channel is examined, and a generalized Ohm's law is introduced to account for the Hall effect. L.E.W.

N66-32803# Joint Publications Research Service, Washington, D. C.
THE RIDDLE OF BALL LIGHTNING
Roal'd Aleksandrovich Leonov 3 Aug. 1966 83 p refs Transl. into ENGLISH of the booklet "Zagadka Sharovoy Molnii" Moscow, Nauka Publishers, 1965 p 3–75
(JPRS-36823; TT-66-33253) CFSTI: $3.00

The phenomenon of ball lightning is considered, and several theories on the nature of such atmospheric discharges are examined. The evolution of the research including observations, experiments, hypotheses, and the application of such research to the field of high power electronics is discussed. A.G.O.

26 PHYSICS, SOLID-STATE

Includes semiconductor theory; and superconductivity. For applications see: 16 Masers. For related information see also: 10 Electronics.

N66-31575# Joint Publications Research Service, Washington, D. C.
ELECTRON MICROSCOPY AND METALLURGICAL STUDIES
23 Jun. 1966 74 p refs Transl. into ENGLISH from Zavodsk. Lab. (Moscow), no. 2, Feb. 1966 p 170–190, 196–202, 212–213, 251–253
(JPRS-36161; TT-66-32595) CFSTI: $3.00

CONTENTS:

1. FUNDAMENTALS OF TRANSMISSION ELECTRON MICROSCOPY V. N. Rozhanskiy p 1–27 refs (See N66-31576 18-26)
2. USE OF DIFFRACTION CONTRAST TO STUDY CRYSTAL DEFECTS V. I. Izotov and L. M. Utevskiy p 28–43 refs (See N66-31577 18-26)
3. INVESTIGATING THE MAGNETIC STRUCTURE OF THIN FILMS WITH THE UEMV-100 ELECTRON MICROSCOPE N. I. Sivkov p 44–46 refs (See N66-31578 18-26)

4. DETERMINING PARTICLE MAGNITUDE IN SYNTHETIC LATEX BY ELECTRON MICROSCOPY S. E. Selivanovskiy, Yu. M. Yakovlev, A. V. Lebedev, and N. A. Fermor p 47–52 refs (See N66-31579 18-18)

5. PREPARING OBJECTS FOR ELECTRON MICROSCOPES BY ETCHING WITH ACTIVE OXYGEN M. R. Kiselev, E. I. Yevko, and V. M. Luk'yanovich p 53–55 (See N66-31580 18-15)

6. OBTAINING OXIDE REPLICAS FOR STUDYING THE STRUCTURE OF Zr–Nb ALLOYS S. V. Sudareva, N. N. Buynov, and V. A. Vozilkin p 56–58 (See N66-31581 18-26)

7. IMAGE AMPLIFIER FOR THE UEMV-100 ELECTRON MICROSCOPE I. F. Anaskin, I. G. Stoyanova, B. L. Kozlov, and V. F. Semenov p 59–63 (See N66-31582 18-14)

N66-31576# Joint Publications Research Service, Washington, D. C.

FUNDAMENTALS OF TRANSMISSION ELECTRON MICROSCOPY

V. N. Rozhanskiy *In its* Electron Microscopy and Met. Studies 23 Jun. 1966 p 1–27 refs (See N66-31575 18-26) CFSTI: $3.00

This survey describes the simple and existing diffraction methods used in transmission electron microscopy. The review shows the value of using diffraction analysis for contrast in the electron microscope image when studying the crystal structure of an object. Further advances in electron microscopy are shown to be associated with the development of multiray dynamic theory, the use of new objects, very high accelerating voltages, very low object temperatures, sharp increases in the microscope resolution until individual atoms in the crystal lattice are resolved, and design progress. R.N.A.

N66-31577# Joint Publications Research Service, Washington, D. C.

USE OF DIFFRACTION CONTRAST TO STUDY CRYSTAL DEFECTS

V. I. Izotov and L. M. Utevskiy *In its* Electron Microscopy and Met. Studies 23 Jun. 1966 p 28–43 refs (See N66-31575 18-26) CFSTI: $3.00

This article discusses the conditions for the appearance of diffraction contrast in an electron image of crystal defects and the change in contrast when a goniometric image stage for the object is used. Martensite crystal defects of the Fe–Ni alloy with a definite twinning system and dislocation Burger's vectors are analyzed crystallographically. The effect of a particular contrast on the wedge shaped vertices of the twin is discussed. R.N.A.

N66-31578# Joint Publications Research Service, Washington, D. C.

INVESTIGATING THE MAGNETIC STRUCTURE OF THIN FILMS WITH THE UEMV-100 ELECTRON MICROSCOPE

N. I. Sivkov *In its* Electron Microscopy and Met. Studies 23 Jun. 1966 p 44–46 refs (See N66-31575 18-26) CFSTI: $3.00

A method has been developed for observing magnetic domains of thin films using the UEMV-100 electron microscope. The device was designed for magnetically reversing the object polarity. Author

N66-31581# Joint Publications Research Service, Washington, D. C.

OBTAINING OXIDE REPLICAS FOR STUDYING THE STRUCTURE OF Zr–Nb ALLOYS

S. V. Sudareva, N. N. Buynov, and V. A. Vozilkin *In its* Electron Microscopy and Met. Studies 23 Jun. 1966 p 56–58 (See N66-31575 18-26) CFSTI: $3.00

Methods were developed to obtain oxide replicas for studying the structure of superconducting Zr–Nb alloys rich in zirconium. Oxidation was performed in boiling solutions of chlorine salts to create corrosion resistant films of pure zirconium. Author

N66-31719# Oak Ridge National Lab., Tenn. Solid State Div.

ON THE TEMPERATURE DEPENDENCE OF THE GINZBURG–LANDAU PARAMETER

S. T. Sekula and R. H. Kernohan [1965] 7 p refs
(Contract W-7405-ENG-26)
(ORNL-P-1221) CFSTI: HC $1.00/MF $0.50

A study of the variation of the strength of the temperature dependence of the Ginzburg–Landau parameter with the degree of coupling in superconductors is summarized. NSA

N66-31776# Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro.

SPONTANEOUS EMISSION OF PHONONS BY CARRIERS IN A PERFECT LATTICE AT 0°K

W. Baltensperger and J. S. Helman 1965 22 p refs *Its* Notas de Fis., Vol. XI, No. 17
CFSTI: HC $1.00/MF $0.50

A charge carrier in a perfect semiconductor at 0°K will spontaneously emit phonons, when its speed exceeds the speed of sound. The average force due to spontaneous emission is evaluated for both normal and Umklapp processes. An approximate solution of the Boltzmann equation shows, that in the vicinity of the speed of sound the excess velocity is proportional to the fourth root of the applied electric field. Author

N66-31828# Technische Hogeschool, Eindhoven (Netherlands).

MAGNETIC ORDERING IN INSULATING SOLIDS

Pieter Adriaan Van Dalen (Ph.D. Thesis) 7 Jun. 1966 126 p refs
CFSTI: HC $3.00/MF $1.00

Magnetic ordering in some insulators is investigated by means of nuclear magnetic resonance and magnetic susceptibility techniques; and the data are analyzed theoretically. Magnetization of powdered K_3MoCl_6 in a static magnetic field is determined by magnetization and susceptibility measurements. The magnetically ordered state of the substances $FeCl_2 \cdot 4H_2O$ and $Cu(COOH)_2 \cdot 4H_2O$ is determined by means of proton resonance. Magnetic resonance of the nuclei of nonmagnetic atoms in magnetically ordered insulators is examined, and a general expression is derived to calculate the dipolar magnetic field caused by electron spin density. The local field at the proton site in $CuCl_2 \cdot 2H_2O$ is calculated numerically by means of the formula derived. Wave functions of the unpaired electron are calculated approximately for molecular orbitals; a model is formulated for the interactions between two localized unpaired electrons; and exchange parameters are compared quantitatively with results derived from experimental data. S.P.

N66-31862# Boeing Scientific Research Labs., Seattle, Wash.

THE FORMATION OF A MAGNETIC PINCH IN InSb AND THE POSSIBILITY OF POPULATION INVERSION IN THE PINCH

Helmut Schmidt Feb. 1966 45 p refs
(DI-82-0502)

It is pointed out that a sufficiently strong current supported by an electron-hole plasma in InSb pinches. As the electron-hole gas is compressed by the current's magnetic field, the plasma temperature increases. The strong electron–phonon coupling, however, keeps the plasma temperature below the characteristic temperature of the optical phonons as long as the lattice remains cold. We discuss this early period of the pinch, which includes the initial contraction and some 10^{-7} sec thereafter. The collapse of the pinch may be halted by an increase of the plasma pressure caused by the exclusion principle or by the occurrence of impact ionization in the pinch's radial Hall field. An estimate of the particle density in the pinch shows that the conditions for population inversion may be satisfied, hence laser action due to stimulated electron-hole recombination might occur. This effect should influence the development of the pinch decisively. Author

N66-31881# Atomic Energy of Canada, Ltd., Chalk River, (Ontario).

RADIATION INDUCED ELECTRON EMISSION

J. G. Bayly and B. G. Chidley Apr. 1966 26 p refs (AECL-2567) CFSTI: HC $2.00/MF $0.50

Electron emission due to gamma irradiation is examined experimentally, and an empirical expression given for the net current between parallel electrodes as a function of the intensity of irradiation and of the applied voltage. The emission from aluminum is one electron/cm^2 for an energy deposition rate of 140 eV/microgram. By extrapolation to the conditions in a power reactor, an estimate of a possible effect of irradiation on corrosion rate can be made. Author

N66-31882# Polish Academy of Sciences, Cracow. Inst. of Nuclear Physics.

TEMPERATURE DEPENDENCE OF THE DEBYE–WALLER FOR 14.4 KeV GAMMA RAYS OF THE ^{57}Fe IMPURITY NUCLEUS IN Zn, Mo, AND Sn CRYSTAL LATTICES

J. Bara, H. U. Cholewa, A. Z. Hrynkiewicz, and T. Matlak Feb. 1966 12 p refs Submitted for Publication (Rept.-459/PL) CFSTI: HC $1.00/MF $0.50

Temperature dependence of the Debye–Waller factor is described, in the first approximation, by an effective Debye temperature calculated under the assumption that force constants for the impurity–host atoms are the same as for the host–host atoms. Author

N66-31988# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.

ANTIFERROMAGNETIC STRUCTURE OF URANIUM DIPHOSPHIDE

Robert Troc (Wroclaw Tech. Univ.), Janusz Leciejewicz, and Roman Ciszewski (Warsaw Tech. Univ.) Feb. 1966 14 p refs (INR-691/II/PS) CFSTI: HC $1.00/MF $0.50

The antiferromagnetic structure of tetragonal UP_2 below Neel point (T_N=203° K) has been determined by neutron diffraction using polycrystalline samples. The magnetic unit cell is twice the chemical one in the direction of the c axis. The magnetic structure is obtained by stacking of ferromagnetic sheets of uranium along the c axis in the order + − − +. The magnetic moments of uranium are pointing in the direction of the c axis; the magnitude is 1.0±0.1 Bohr magnetons. Author

N66-32066*# California Univ., Santa Barbara.

THE ULTRAVIOLET REFLECTION SPECTRUM OF CADMIUM SULFIDE

W. C. Walker and J. Osantowski *In* NASA. Goddard Space Flight Center Publ. of Goddard Space Flight Center, 1963, Vol. II [1963] p 611–612 refs (See N66-32044 18-31) CFSTI: HC $7.00/MF $5.00

Measurements on the incidence reflection spectrum of a freshly cleaved CdS crystal for photon energies from 4 to 28 eV were made at room temperature in a vacuum reflector maintained at 10^{-5} torr. The reflection spectrum obtained from averaging several sets of data showed valence to conduction ban transition peaks at 5.6, 7.1, 7.9, 9.3, and 9.7 eV. Higher energy peaks were observed at 14.4, 16.1, and 17.4 eV due to mixed band transitions of cadmium 4d electrons and sulfur 3s electrons. The 7.1, 7.9 eV doublet was clearly resolved and an additional doublet at (9.3, 9.7) eV was tentatively assigned to the spin-orbit doublet (Γ_7, Γ_9)→Γ_7 derived from a degenerate $\Gamma_5 \rightarrow \Gamma_1$ transition of the wurtzite structure. The triplet structure in the high energy peak was attributed to the joint density states from the cadmium 4d, sulfur 3s, and conduction bands. G.G.

N66-32079*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

ON THE TEMPERATURE DEPENDENCE OF THE BREAKDOWN FIELD OF Ba–Ti–O_3

P. H. Fang *In its* Publ. of Goddard Space Flight Center, 1963, Vol. II [1964] p 980–981 refs (See N66-32044 18-31) CFSTI: HC $7.00/MF $5.00

Different experimental results for temperature dependence of the breakdown field of ceramic BaTiO electrode material were attributed to the various geometrical shapes of the investigated specimens. Samples with a spherical cavity showed a minimal thermal breakdown due to conduction of the generated heat by the surrounding medium. Samples of planar disk form, immersed in silicon insulation liquid, were not subjected to intensive heat conduction and showed normal thermal breakdown processes; minimization of the breakdown strength near transition temperatures emphasized the contribution of the electric conductance current due to polarization effects. Differences in the breakdown behavior of pure specimens indicated the influence of impurities on the temperature dependence of the breakdown field. G.G.

N66-32094# Library of Congress, Washington, D. C. Aerospace Technology Div.

ORGANIC SEMICONDUCTORS Surveys of Soviet Scientific and Technical Literature

Serge Markov 1 Apr. 1966 41 p refs Anal. Surv. (ATD-66-36; AD-633276) CFSTI: HC $2.00/MF $0.50

The subject of this survey is basically Soviet research on the electrical properties of organic semiconductors and photoconductors. Material has also been included dealing with the preparation of such products. Known or potential, and with their structure, morphology, and magnetic properties insofar as these are associated with electrical properties. The Introduction includes remarks about the importance attached to this research in the Soviet Union as well as a table listing the facilities associated with this research, involved scientists whose associations could be determined, and the appropriate references. The Analytical Section contains four parts: A. Heat-treated polyacrylonitrile, B. Irradiated and heat-treated polyethylene, C. Modified chlorine-containing polymers, and D. Modified poly (vinyl alcohol). In the Annotated Bibliography the 45 entries are grouped under the same four subject headings as listed above with the following distribution: A–19 entries, B–14 entries, C–10 entries, and D–2 entries. Within each subject area the entries are arranged chronologically in order of data of submittal to the editor to give some idea of

the progress in time of the research. There are three lists appended to the report: 1. List of sources searched; 2. Author index; and 3. Association Index. (TAB)

N66-32109*# Carnegie Inst. of Tech., Pittsburgh, Pa.
EPITAXIAL GROWTH OF GALLIUM ARSENIDE WITH AMMONIUM HALIDES AS TRANSPORTING AGENTS
He Bong Kim and Richard L. Longini [1964] 41 p refs
(Contract NAS8-5269)
(NASA-CR-76429) CFSTI: HC $2.00/MF $0.50 CSCL 20L

The epitaxial growth of gallium arsenide on gallium arsenide are made utillizing the close-spaced source-seed ensemble in a closed system. Combinations of the low indux or orientations of [100], [110], and [111] as well as the polycrystalline samples, are used to determine the relative rates of the nucleation and growth on the low index orientations. Stacking faults, dislocations, and twin boundaries are observed and their configurations are studied. Early stages of the growth on the low index crystallographic orientations are observed and the configurations of the growth are compared with the etch pits. The rates of growth on the low index planes determined by the close-spaced epitaxial growth, can probably be explained by the atomistic model of the growth of facets. Ammonium halides such as NH_4Cl, NH_4I, and NH_4Br are shown to be useful transporting agents of gallium arsenide. The composition of the gas phase in equillibrium with solid GaAs is calculated for various temperatures, pressures, and component ratios. The principle species under equillibrium conditions are H_2, N_2, $GaCl_3$, HCl, As_4, NH_4Cl, GaCl, NH_3 and $AsCl_3$. Author

N66-32182# General Electric Co., Philadelphia, Pa. Missile and Space Div.
COHESIVE ENERGY OF THE NOBLE METALS
Irwin M. Pikus (Ph.D. Thesis, Temple Univ.) Apr. 1966 189 p refs
(R66SD23)

A review of the general theory of metallic cohesion and its application to many metals is presented. The failure of the theory to explain cohesion in the noble metals is contrasted with the remarkable success in the cases of alkali metals, certain polyvalent metals, and some materials normally considered covalent. The noble metal problem is examined in some detail and the role of the d-electrons in cohesion is discussed. A method is hypothesized for determining the participation of the d-electron in cohesion from the free atom d-wave functions. Calculations of the d-contribution to cohesion and compressibility as well as their influence on the crystal structure ensue. This leads to an improved agreement between theory and experiment. Author

N66-32204# John Carroll Univ., Cleveland, Ohio.
ULTRASONIC ATTENUATION IN SUPERCONDUCTING NIOBIUM
Joseph H. Simmons (M.S. Thesis) 1966 72 p refs

The attenuation of ultrasonic waves with frequencies between 30 and 330 MHz was investigated in niobium single crystals oriented in the (100) and (110) crystal directions. The dependence of the attenuation on temperature was observed with samples in different background magnetic fields. The temperature dependent energy gap was calculated from the observed attenuation using the B.C.S. model, for the two crystal orientations. The experiment was performed on both pure and impure niobium single crystals. Both longitudinal and shear waves were utilized to determine gap anisotropy. The attenuation of low frequency ultrasonic waves was carefully studied in an effort to observe the collective excitation modes for electrons in the superconducting state corresponding to pressure waves in a neutral Fermi gas. Finally, amplitude dependence of the attenuation of the type observed by Love and Shaw in lead was investigated. Author

N66-32259*# Rice Univ., Houston, Tex. Dept. of Electrical Engineering.
EFFECT OF DIMENSIONS ON THE EFFICIENCY OF RADIANT ENERGY CELLS
G. C. Jain and Sheng-san Li [1966] 18 p refs Presented at the Internatl. Congr. and Exhibition of Electron. and Atomic Energy, Rome, 15–26 Jun. 1966
(Grant NsG-6)
(NASA-CR-76719) CFSTI: HC $1.00/MF $0.50 CSCL 20L

This work deals with the enhancement of the quantum efficiency and photovoltaic energy conversion efficiency of a p–n semiconducting cell by optimizing the dimensions of the cell. Based on the Shockley–Read statistics a general expression for the quantum efficiency of monochromatic incident radiant energy photons has been derived in terms of the absorption coefficient of the incident photons, the minority carrier diffusion length, the built-in electrostatic field appearing in diffused cells and the surface recombination velocity in the exposed layer of the cell. Although the expression derived may be used for all semiconducting p–n cells, special efforts have been made in the analysis and computations of the germanium p–n cell. The germanium cells show a great potential for photovoltaic energy conversion from radiant sources other than the sun. The results for germanium indicate that the quantum efficiency strongly depends upon the thicknesses of the exposed and base layers. The built-in electrostatic field and the surface recombination velocity in the exposed layer influence the quantum efficiency greatly. Author

N66-32286*# Westinghouse Electric Corp., Baltimore, Md. Aerospace Div.
SEMICONDUCTOR WAFER IMPROVEMENT THROUGH PHOTOENGRAVING Final Report, 17 Jun. 1964–11 Jan. 1965
C. J. Taylor [1965] 69 p refs
(Contract NAS5-2755)
(NASA-CR-76745) CFSTI: HC $2.50/MF $0.75 CSCL 20L

The preparation of a silicon wafer surface before application of photoresist to improve the resist adhesion is reported. Several processes for obtaining oxide surfaces were investigated: effect of changing oxidation temperature, variation of gas flow rates and furnace ambient composition, comparison of steam oxidation and thermal oxidation, and preparation of oxide with silicon tetrachloride and carbon dioxide. The effects of varying the resist coating thickness through changing spin speed, acceleration, and dilution of solutions were also studied. The use of various chelating agents, wetting agents, and surfactants to find a linkage to bond the open chain end of the resist to the surface of the oxide were investigated. A metal etch resist and a thin film resist were found to possess better adhesion than other resists. A method of modifying the metal etch resist by eliminating globular matter appeared capable of meeting the high resolution photoengraving requirements. It was found that humidity adversely affected resist adhesion especially above 40%, and extensive cleaning procedures degraded adhesion of resist for the oxide. An additive to the developer allowed line widths of .00025 in. to be etched while maintaining a yield in pinhole free areas of 3600 square mils of 93%. L.E.W.

N66-32299*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

INVESTIGATION OF A PROPOSED TECHNIQUE FOR MEASUREMENTS OF DIELECTRIC CONSTANTS AND LOSSES AT V-BAND USING THE FABRY-PEROT PRINCIPLE

Constantine A. Balanis (M.S. Thesis—Virginia Univ.) Aug. 1966 92 p refs

(NASA-TM-X-57770) CFSTI: HC $2.50/MF $0.75 CSCL 20L

The difficulties existing in applying methods consistently used for the measurements of dielectric constants and losses in lower microwave frequencies at millimeter waves are presented. A method using a Febry-Perot interferometer as a resonant cavity for the measurements of dielectric constants and losses in the millimeter region is discussed. The advantages of using such a system are that its physical dimentions are many times larger than the operating wavelength and a relative high Q can be obtained thus providing a system of high sensitivity in the measurements of dielectric constants and losses. Experimental data of dielectric constants and losses for teflon, polystyrene and plexiglas are presented at approximately 60 GHz. Samples of several thicknesses and various surface finishes were used and the results compared. Also, comparison with data at lower microwave frequencies was made. Values of dielectric constants in a small frequency band were measured at constant temperature. To determine the effect of temperature on the dielectric properties at millimeter waves, the dielectric constant was measured at different temperatures. Author

N66-32319# France. Ministere de l'Air, Paris.

TUNNEL EFFECT IN THE ESAKI DIODES. PARTICULAR RESEARCH ON THE PHYSICAL PHENOMENA LINKED TO THE OPERATION OF THE GERMANIUM DIODES AT LOW TEMPERATURES [EFFET TUNNEL DANS LES DIODES ESAKI. RECHERCHES PARTICULIERES SUR LES PHENOMENES PHYSIQUES LIES AU FONCTIONNEMENT DES DIODES DE GERMANIUM AUX BASSES TEMPERATURES]

Pierre Andre Serv. de Doc. Sci. et Tech. de l'Armement, 1966 116 p refs In FRENCH

(NT-150) CFSTI: HC $3.00/MF $0.75

The tunnel effect current is calculated taking into account variations in the electric field from one end of the diode to the other. The quantitative phenomenon is explained. The BKW stationary state is expressed based on the egg-shaped curve obtained by the interband junction method. The cases of germanium and gallium antimonide are considered for direct polarization diodes. Some experimental results are reviewed. In particular, the theory provides a satisfactory value for the subtangent at the inflection point, which is a very important parameter for background noise. Transl. by J.G.

N66-32427*# Chicago Univ., Ill. Dept. of Physics and Inst. of Metals.

ELECTRONIC SPECTRUM OF CRYSTALLINE ANTIMONY

P. J. Lin and J. C. Phillips [1965] 45 p refs

(Grant NsG-352)

(NASA-CR-76754) CFSTI: HC $2.00/MF $0.50 CSCL 20L

The energy levels and interband oscillator strengths of antimony have been calculated at ~90,000 points in the Brillouin zone by the pseudopotential method. The potential used was obtained with no adjustment of parameters from empirical form factors of the semiconductors grey Sn and InSb. This potential had previously been used to obtain Fermi surfaces for electrons and holes in Sb in good agreement with experiment. The present calculation agrees well with optical data of Cardona and Greenaway in the energy interval 0.5 eV–8.0 eV with $\underline{E}$ polarized perpendicular to the trigonal axis. Polarization effects of order 10–20% are predicted by the calculation. The regions of the Brillouin zone contributing most strongly to the calculated structure are identified, and predictions are made concerning spin-orbit splittings of the observed peaks. Application of the analysis to As, Bi, and IV–VI semiconductors is discussed. Author

N66-32431*# Carnegie Inst. of Tech., Pittsburgh, Pa. Dept. of Electrical Engineering.

THE NATURE OF A MOVING DISLOCATION BAND FOUND WHEN ZINC IS DIFFUSED INTO GALLIUM ARSENIDE

H. B. Kim and R. L. Longini [1965] 37 p refs

(Contract NAS8-5269)

(NASA-CR-76755) CFSTI: HC $2.00/MF $0.50 CSCL 20L

Some experimental observations on the moving dislocation band and the p–n junction planarity under various diffusion conditions were explained qualitatively in terms of the moving band model. Experimental procedures for preparing single crystal n-type Te-doped GaAs wafers are detailed, and etch pit density profiles are given. It is theorized that zinc diffuses interstitially with the zinc mostly becoming substitutional and relatively immobile at the band of dislocation. The restricted volume of the dislocation band permits regions to exist where the interstitial zinc is far from its equilibrium relationship with substitutional zinc; it is, rather, the result of rapid diffusion from regions of higher concentration. This diffusion profile is divided into three regions; comparative data on each are given. It was concluded that the moving dislocation band model showed qualitative agreement with the experimental observations: (1) It accounts for the dislocation band observed in the diffused region when zinc has been the diffusant in gallium arsenide. (2) It supports the concentration dependent diffusion mechanism involving the interstitial–substitutional species. M.G.J.

N66-32435*# Chicago Univ., Ill. Inst. for the Study of Metals.

THEORY OF SURFACE ION NEUTRALIZATION

Volker Heine Mar. 1966 18 p refs

(Grant NsG-352)

(NASA-CR-76759) CFSTI: HC $1.00/MF $0.50 CSCL 20K

The formal theory of surface ion neutralization is given. [An electron from a filled state in the conduction band in a solid tunnels onto a rare gas ion on the surface to neutralize it, the energy drop $\pi\omega$ being used to excite another electron from the band to a sufficiently high state that it can escape from the metal into a collector.] Because of the large energy $\pi\omega$, the Coulomb interaction which is responsible for the process is effectively unscreened, but it is shown that the long range of the unscreened potential does not lead to any divergences which might be expected in calculating the emergent current. The ejected electrons originate in the first few atomic layers of the solid and some even outside it. The variations of the matrix element and of the transmission coefficient through the surface can explain some directional dependence observed in the measurements. Author

N66-32436*# Chicago Univ., Ill. Inst. for the Study of Metals.

EXCITON AND IMPURITY STATES IN RARE GAS SOLIDS

J. Hermanson (Ph.D. Thesis) [1965] 62 p refs

(Grant NsG-352)

(NASA-CR-76760) CFSTI: HC $2.50/MF $0.75 CSCL 20L

The formalism of the preceding paper is applied to a calculation of the first excited states of (1) pure crystals of Kr and Xe; and (2) rare gas solids containing a substitutional

Xe impurity. A Hartree potential for the bare electron-hole interaction is constructed for each system, and is screened within the random phase approximation. Matrix elements of the corresponding pseudopotentials, projected according to the Cohen–Heine prescription, are derived in the Wannier representation. Band structures inferred from optical data are fitted to simple interpolation formulae. By transformation to a symmetric representation for the envelope function, the Wannier difference equations are reduced to manageable form and solved by a matrix technique. Although the calculations contain no disposable parameters, obtained binding energies and oscillator strengths are found to be in excellent agreement with experiment. Author

N66-32443*# Massachusetts Inst. of Tech., Cambridge.
RESEARCH IN MATERIALS SCIENCE AND ENGINEERING Annual Report, 1965–1966
Charles H. Townes Apr. 1966 458 p refs
(Contract NAS3-2590; ARPA SD-90; Nonr-1841(10); DA-19-020-AMC-0231(X); AF 04(694)-305 et al)
(NASA-CR-76778; AD-632762) CFSTI: HC $5.07/MF $2.25 CSCL 20L

This is the fifth annual report on research in materials science and engineering at the Massachusetts Institute of Technology. Topics included are chemical and solid state physics; electric, magnetic, and optical properties of materials and applications to devices; metallurgy and materials science; and materials engineering. TAB

N66-32648# United Kingdom Atomic Energy Authority, Harwell (England). Metallurgy Div.
ON THE CHANNELLING OF PROTONS IN IONIC SOLIDS
R. S. Nelson Mar. 1966 22 p refs
(AERE-R-5176)

This paper is concerned with the theoretical aspects of the channelling of protons in the simple ionic solids of the rock-salt and caesium-chloride structures. It is shown that the electrostatic fields occurring between the constituent positive and negative ions can affect the trajectories of protons travelling along certain crystal directions. In particular, the ions currounding the <100> direction of the rock-salt structure form a series of electrostatic quadrupole lenses which constrain the proton's path to the central region of the channel. This quadrupole effect is compared to the channelling produced by the interaction with the exponentially screened Coulomb potential of the nuclei, and is shown to be significant only at relatively low proton energies below 10 keV. Author

N66-32652# United Kingdom Atomic Energy Authority, Harwell (England). Solid State Physics Div.
THE ANGULAR DISTRIBUTION OF NEUTRONS SCATTERED AT SMALL ANGLES BY FERROMAGNETIC SPIN WAVES
M. W. Stringfellow Mar. 1966 50 p refs
(AERE-R-4535) HMSO: 6s

The angular distribution of neutrons scattered at small angles by ferromagnetic spin waves is derived analytically for a quadratic spin wave dispersion relation $\omega = Dq^2$. It is shown that the distribution has a wavelength-independent cut-off angle, and that when the scattering is measured using a counter with a slit of infinite length perpendicular to the scattering plane and the specimen is magnetized first parallel and then perpendicular to the scattering angle, in a plane at right angles to the primary beam, the difference between the two distributions has a simple rectangular form. The limits of validity of the quadratic approximation are discussed, and it is shown that neglect of the dipole-dipole and magnetic field terms leads to significant error when the cut-off angle is less than 1°. When these terms are taken into account exactly the calculation cannot be treated analytically, but must be carried out numerically. Author

27 PROPELLANTS

Includes fuels; igniters; and oxidizers. For basic research see: 06 Chemistry; and 33 Thermodynamics and Combustion. For related information see also: 28 Propulsion Systems.

N66-32585# Joint Publications Research Service, Washington, D. C.
PHYSICAL AND CHEMICAL FUNDAMENTALS IN THE USE OF MOTOR, JET AND ROCKET FUELS
G. F. Bol'shakov, Ye. I. Gulin, and N. N. Torichnev 27 Jul. 1966 347 p refs Transl. into ENGLISH of the book "Fiziko-Khimicheskiye Osnovy Primeneniya Motornykh, Reaktivnykh i Raketnykh Topliv" Moscow, Izd-vo "Khimiya", 1965 270 p
(JPRS-36701; TT-66-33132) CFSTI: $7.00

The physiochemical principles of motor, jet, and rocket fuels in engines under operational conditions are discussed. The properties of pumpability, cooling, volatility, ignition and combustion, stability, corrosiveness, and toxicity of fuels are considered. Four groups of existing liquid fuels are examined: automobile and aviation gasoline, and diesel, jet, and rocket fules. The characteristics of fuels for gas turbines and residual fuel oil for boilers are excluded from the investigation. S.P.

N66-32665# Weapons Research Establishment, Salisbury (Australia).
COMPOSITE PROPELLANTS. PART XI: POLYOXYPROPYLENE POLYURETHANE RUBBER BINDERS RELATIONSHIPS OF PROPERTIES TO POLYMER STRUCTURE
J. E. Stutchbury and S. Hryhorciw Nov. 1965 45 p refs
(CPD-103) CFSTI: HC $2.00/MF $0.50

The glass transition temperatures and tensile properties of polyoxypropylene polyurethane rubbers have been measured. The rubber formulation was varied by using glycols of various molecular weights, several polyol crosslinkers and both aromatic and aliphatic isocyanates. Some rubbers were plasticized with esters. The glass transition temperature was found to be dependent mainly on the urethane group concentration and could be lowered by reducing urethane content, by using an aliphatic isocyanate and by plasticization. Branched chain aliphatic esters were more effective plasticizers than straight chain esters. Tensile strength was dependent on the difference between ambient test temperature and T_g rather than urethane content and the strength of all rubbers could be plotted against this temperature difference, which showed tensile strength to be strongly temperature dependent. Elongation appeared to follow a similar pattern. Author

28 PROPULSION SYSTEMS

Includes air breathing, electric, liquid, solid, and magnetohydrodynamic propulsion. For nuclear propulsion see: 22 Nuclear Engineering. For basic research see: 23 Physics, General; and 33 Thermodynamics and Combustion. For applications see: 31 Space Vehicles. For related information see also: 27 Propellants.

N66-31419# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CERTAIN RESULTS OF INVESTIGATION OF A CENTRIPETAL GAS TURBINE WITH NOZZLE ADJUSTMENT

A. I. Loshkarev and B. N. Bryukhanov 18 Nov. 1965 27 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedeniy Mashinostr. (Moscow), no. 2, 1963 p 208–223 (FTD-MT-64455; TT-65-64793; AD-624767) CFSTI: HC $2.00/MF $0.50

Selection of parameters for a projected centripetal turbine is first mathematically performed. The principles of profiling the rotor of a centripetal gas turbine with 24 straight radial blades are then presented. The meridional profile of the rotor is calculated from three-dimensional flow in the natural system of coordinates. Hydraulic loss in the rotor is reduced by distribution of velocities in the interblade channel. The angle of exit flow from nozzles is determined. Change of moment and power absorption was achieved with a high-speed hydraulic brake. Torque was measured by hydro-optical scales. Four 4-zone Pitot tubes were used for pressure measurements at the nozzle inlet and outlet. Temperature, pressure, and angle of flow were measured. Blade erosion due to solid particles in the air occurred during the test. The erosion was analyzed and the effect on the power efficiency of the turbine was calculated. K.W.

N66-31625*# Aerojet-General Corp., Sacramento, Calif.

MECHANICAL DESIGN OF A CURTIS TURBINE FOR THE OXIDIZER TURBOPUMP OF THE M-1 ENGINE

E. Roesch 15 Jun. 1966 169 p refs

(Contract NAS3-2555)

(NASA-CR-54815; AGC-8800-72) CFSTI: HC $5.00/MF $1.00 CSCL 21E

The mechanical design of the 36,000 horsepower 4,000 rpm turbine for the M-1 engine oxidizer turbopump is described. Unusual design features include an inlet manifold which is integral with the backplate of the adjacent centrifugal pump, and the light-weight hollow blade stator and rotor designs principally made possible by electron-beam welding fabrication techniques. Inconel 718 alloy is used almost exclusively. The technology used in fabricating the unitized turbine inlet manifold and pump backplate assembly is also discussed. Author

N66-31649# Aerospace Research Labs., Wright-Patterson AFB, Ohio. Fluid Dynamics Facilities Lab.

SUPERSONIC COMPRESSOR RESEARCH

John W. Steurer *In* Office of Aerospace Res. Proc. of the OAR Res. Appl. Conf. [1966] p 31–43 refs (See N66-31646 18-34) CFSTI: HC $5.00/MF $1.00

Supersonic compressors offer the advantages of lightness of weight, compactness, and simplicity of design due to high pressure ratios per stage and high inlet Mach numbers. This paper describes: (1) a new concept of supersonic compressor blading, (2) a mathematical model of the flow process developed for performance prediction and optimization purposes, (3) a description of and some preliminary results of the experimental program currently underway. Author

N66-31650# Aerospace Research Labs., Wright-Patterson AFB, Ohio.

THE ARL INTERTIAL PARTICLE SEPARATOR FOR MILITARY TURBINE POWERED VEHICLES

Roger A. Miller and Robert Poplawski *In* Office of Aerospace Res. Proc. of the OAR Res. Appl. Conf. [1966] p 45–69 refs (See N66-31646 18-34) CFSTI: HC $5.00/MF $1.00

A brief description is given of the history, general results, and theoretical considerations involved in microscopic particle separation research. One specific application of this research, an inertial particle separator for military turbine vehicles, and future plans for this particular by-product are also discussed. Consideration is given to fundamental flow pattern studies, experimental dust separation research, and various applications of the resultant methods. C.T.C.

N66-31938*# Pratt and Whitney Aircraft, West Palm Beach, Fla.

SINGLE STAGE EXPERIMENTAL EVALUATION OF SLOTTED ROTOR AND STATOR BLADING. PART I: ANALYSIS AND DESIGN

Charles G. Linder and Burton A. Jones 27 Jul. 1966 93 p ref

(Contract NAS3-7603)

(NASA-CR-54544; PWA-FR-1713) CFSTI: HC $2.50/MF $0.75 CSCL 20A

A program was initiated to establish the feasibility and extent to which slotted blade concepts can be utilized to increase the allowable blade loadings and stable operating range of subsonic compressor stages. As part of this program, analysis and design of the hardware required were made. Vector diagrams for three slotted rotors with tip diffusion factors of 0.53, 0.59, and 0.70 and three slotted stators with hub diffusion factors of 0.60, 0.67, and 0.76 were established. These blade rows, along with supporting hardware such as a flow generation rotor and wall bleed system, were then designed. Author

N66-31942*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

EXPERIMENTAL INVESTIGATION OF A HIGH-VOLTAGE ISOLATION DEVICE FOR ION-THRUSTOR PROPELLANT FEED

Shigeo Nakanishi Washington, NASA, Aug. 1966 32 p refs (NASA-TN-D-3535) CFSTI: HC $2.00/MF $0.50 C5CL 21C

This investigation extends the operating range of a high-voltage isolation device for the propellant-feed system of an ion thrustor. Some geometrical and operational parameters pertinent to electrical breakdown through the device (a nonconductive tube) are defined. Potentials to 10,000 V were maintained within 14.6 cm of a grounded surface at a propellant flow rate of 14.2×10^{-4} g/sec and an estimated maximum tube pressure of 0.075 mm of mercury. Ions from the thrustor are believed responsible for processes that lead to a breakdown. Deionizer pads with high ratios of surface area to volume were effective in reducing the leakage current through the tube. Two pads of low density were more effective than a single pad of high density. The locations of these pads relative to the ground electrode and to each other were significant factors in the critical voltage limit. Comparison of a stainless steel and a carbon ground electrode showed only minor differences in leakage current and breakdown voltage, which indicates that the secondary electron coefficient of these electrodes is of minor importance. Author

N66-31962# Deutsche Versuchsanstalt für Luft- und Raumfahrt, Porz (West Germany). Institut für Angenandte Gasdynamik.

INVESTIGATION OF POWER PLANT INLETS [UNTERSUCHUNGEN AN TRIEBWERKSEINLAEUFEN]

W. Trommsdorff May 1966 74 p refs In GERMAN; ENGLISH summary Supported in part by the Bundeswirtschaftsministeriums

(DLR-FB-66-34; DVL-505) CFSTI: HC $2.50/MF $0.75

The requirements for optimum diffusers are investigated. Using a one-parameter family of double-shock diffusers it is shown that the best efficiency of an appended ramjet of optimum design will not be obtained with a diffuser having the best pressure recovery on account of the associated high external drag. Flow fields are computed for multi-shock diffusers, for most readily fabricated diffusers, and for diffusers with both internal and external isentropic compression. Tests and measurements are performed in the region of medium supersonic velocities. A device for suppressing the diffuser buzz is described. For the case of an axially symmetric diffuser with external compression, a procedure is presented how to adapt the stepped edges of the central body to variable flight Mach numbers. Author

N66-32058*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

AN APPROXIMATION METHOD FOR DETERMINATION OF PROPULSION REQUIREMENTS ASSOCIATED WITH LOW THRUST COPLANAR ORBITAL TRANSFER IN A CENTRAL FORCE FIELD UNDER NEGLIGIBLE EXTERNAL PERTURBATIONS

Kenneth I. Duck *In its* Publ. of Goddard Space Flight Center, 1963, Vol. II [1963] p 391–401 refs (See N66-32044 18-31) CFSTI: HC $7.00/MF $5.00

This report presents a method for estimating propulsion system requirements associated with low thrust orbital transfer in a central force field under negligible external perturbations. It is intended to provide a useful analytical tool for sizing propellant storage requirements, estimating propulsion system weights, total impulse requirements, and transfer time. Equations are developed for transfer time and orbital eccentricity as functions of orbital elements, initial thrust to mass ratio, and propellant specific impulse. It is shown that this method is applicable for cases where initial thrust to mass ratios are equal to or less than 10^{-2} ft/sec^2 over a range of near circular orbital altitudes up to the twenty-four hour synchronous point. Comparison of the approximation method with numerical integration of the equations of motion using an IBM 7094 computer shows close agreement for selected cases reported herein. The results are presented in the form of parametric curves to enable the determination of propulsion requirements upon specific mission applications. The buildup of eccentricity was investigated and is shown to be relatively small for the cases studied. Author

N66-32114*# Martin Co., Denver, Colo.

PRESSURIZATION SYSTEM FOR USE IN THE APOLLO SERVICE PROPULSION SYSTEM Interim Report

D. N. Gorman and G. R. Page Jul. 1965 252 p refs (Contract NAS9-3521)
(NASA-CR-65314; CR-65-50) CFSTI: HC $3.75/MF $1.50 CSCL 21H

In the development of an advanced, lightweight, fuel-tank pressurization system for use in the Apollo service propulsion system, three candidate systems were designed and analyzed; a single system was selected as a prototype for subsequent testing. Experimental results showed that gas molecular weight could be reduced from 4 to 2 by replacing helium with hydrogen. It was found that systems utilizing hydrazine monopropellant gas generator gases as fuel tank pressurants are very efficient from a weight standpoint, and that a weight reduction of 370 pounds can be achieved by reducing the gas storage temperature of an Apollo-like system to 37°R. The cascade concept of introducing warmer helium directly in to the storage tank is considered to be the lightest method of increasing residual gas temperature and thereby residual mass. It was pointed out that the incorporation of the cascade system into the Apollo service would result in a 535-pound weight savings; since this was considered satisfactory from every other aspect examined, it is the recommended system. R.Ll.

N66-32168# France. Office National d'Etudes et de Recherches Aerospatiales, Chatillon-sous-Bagneux.

RESEARCH AND ACTIVITY IN ENERGY AND PROPULSION [MOYENS DE RECHERCHES ET ACTIVITE DE LA DIRECTION ENERGIE ET PROPULSION]

[1966] 36 p In FRENCH
CFSTI: HC $2.00/MF $0.50

Technological research and experiments were conducted in the fields of aerothermodynamics, theoretical physics, and cryogenics; various types of rocket engine propulsion systems were studied. Analytical data are reported for chemical and non-chemical propulsion, and for ionic, jet, electric, electromagnetic and electrostatic systems. Experimental tests were made on plasma accelerators, gas generators, supersonic combustion, nozzle efficiency, and lithergolic propellants.
Transl. by R. Ll.

N66-32186*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

DESIGN AND COOLING PERFORMANCE OF A DUMP-COOLED ROCKET ENGINE

Albert J. Pavli, Jerome K. Curley, Philip A. Masters, and R. M. Schwartz Washington, NASA, Aug. 1966 47 p refs
(NASA-TN-D-3532) CFSTI: HC $2.00/MF $0.50 CSCL 21H

A dump-cooled engine was designed and experimentally evaluated as a 500-pound-thrust rocket engine operating at 100-psig chamber pressure with gaseous hydrogen and liquid oxygen as propellants and liquid hydrogen as a coolant. Fourteen firings were made; of these, the last four were with a refractory coating of aluminum oxide on the flame-side surface. Data showing the measured and analytical heat fluxes along with coolant temperatures and pressures through the engine for various coolant flows are presented as a means of determining the minimum satisfactory coolant flow and of checking the validity of the design technique used. The projected potential of dump cooling was investigated by using an analytical performance prediction that assumed a high-temperature inner shell (molybdenum). The results indicated that the coolant exit temperature could be made high enough to yield coolant specific impulses up to and perhaps greater than the specific impulse of the main combustion process. Author

N66-32189*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

COMPRESSED-AIR MODEL INVESTIGATION OF SOLID ROCKET OVERPRESSURES DUE TO INTERFERENCE FROM AFT-END IGNITION ROCKET

Reino J. Salmi Washington, NASA, Aug. 1966 23 p refs
(NASA-TN-D-3537) CFSTI: HC $1.00/MF $0.50 CSCL 21H

An experimental investigation was made to determine the effects on the combustion chamber pressure of a large, solid-propellant, booster rocket due to an aft-end ignition rocket firing into the booster grain port through the exhaust nozzle. The results indicated that the igniter interference could cause large overpressures in the booster-rocket combustion chamber. The magnitude of the interference effect due to the ignition rocket was dependent on the ignition-rocket position, diameter, pressure ratio, and weight flow. At low igniter-to-booster chamber-pressure ratios, which correspond to the condition where the booster rocket is at its design chamber pressure, the interference effect varied greatly with igniter position. Increases in the booster chamber pressure to 60

percent, depending on ignition-rocket geometry, occurred when the igniter was 0.2 of the booster throat diameter downstream of the nozzle throat. At a station corresponding to 0.6 diameter, the interference effects were generally negligible. At high igniter-to-booster pressure ratios, which reflect the low booster chamber pressures at the initial ignition phase, the booster chamber pressure was greatly increased by the igniter jet, as would be desired for rapid ignition; however, the position of the ignition rocket in the booster nozzle had little effect. Author

N66-32313# Office of Naval Intelligence, Washington, D. C. Translation Section.
LIQUID FUEL ROCKET ENGINES FOR AIRCRAFT [LES PROPULSEURS FUSEES A LIQUIDES POUR AVIONS]
Paul Douessin [1966] 8 p ref Transl. into ENGLISH from Forces Aeriennes Francaises (France), no. 193, Jun. 1963 p 883–896
(ONI-TRANS-970; TT-66-61261; AD-632862) CFSTI: HC $1.00/MF $0.50

Past achievements and 1963 state-of-the-art of international liquid fuel rocket engine development for aircraft are reported. French developments and potentials are emphasized. K.W.

N66-32316*# Bell Aerosystems Co., Buffalo, N. Y.
PHOTOGRAPHIC INVESTIGATION OF PROPELLANT STREAM BEHAVIOR IN A FIRING ROCKET ENGINE, VOLUME II Technical Summary Report, 1 Aug. 1964–28 Feb. 1965
T. G. Rossman, R. N. Eulner, and L. M. Wood 24 Jun. 1966 69 p *Its* Rept.-9136-950001
(Contract NAS8-11364)
(NASA-CR-76722) CFSTI: HC $2.50/MF $0.75 CSCL 21B

A series of photographs are presented which show the behavior of propellant streams emerging from the injector face of a rocket motor. Also included are diagrams of the propellant distribution, the test apparatus, and the optical systems used for the shadowgraph photography. E.A.O.

N66-32330*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DISTRIBUTED PARAMETER ANALYSIS OF PRESSURE AND FLOW DISTURBANCES IN ROCKET PROPELLANT FEED SYSTEMS
Robert G. Dorsch, Don J. Wood, and Charlene Lightner (Kentucky Univ.) Washington, NASA, Aug. 1966 55 p refs
(NASA-TN-D-3529) CFSTI: HC $3.00/MF $0.50 CSCL 21H

A digital distributed parameter model for computing the dynamic response of propellant feed systems is formulated. The analytical approach used is an application of the wave-plan method of analyzing unsteady flow. Nonlinear effects are included. The model takes into account locally high compliances at the pump inlet and at the injector dome region. Examples of the calculated transient and steady-state periodic responses of a simple hypothetical propellant feed system to several types of disturbances are presented. Included are flow disturbances originating from longitudinal structural motion, gimbaling, throttling, and combustion-chamber coupling. The analytical method can be employed for analyzing developmental hardware and offers a flexible tool for the calculation of unsteady flow in these systems. Author

N66-32334*# Aerojet-General Corp., Sacramento, Calif.
HYDRAULIC DESIGN OF THE M-1 LIQUID HYDROGEN TURBOPUMP
J. Farquahr and B. K. Lindley 15 Jul. 1966 106 p refs
(Contract NAS3-2555)
(NASA-CR-54822; AGC-8800-68) CFSTI: HC $3.00/MF $0.75 CSCL 21H

This report presents the design method and resulting design details as well as performance predictions for a ten-stage, axial flow, hydrogen pump for the M-1 oxygen/hydrogen liquid rocket engine. The pump is designed to supply 800 lb/sec of hydrogen at a pressure rise of 1890 psi. The pump stage complement consists of a low hub ratio inducer stage with untwisted rotor blading followed by a lightly-loaded stage, called the transition stage, and eight main stages. The main stages are designed for free vortex head generation, with 50% reaction at the blade rest and a tip diffusion factor of 0.4. The transition stage is designed to provide uniform radial head distribution for the first main stage. A C-4, or modified C-4 circular arc blading is utilized for all blade rows with the exception of the inducer rotor and discharge housing turning vanes. Author

N66-32645*# Southwest Research Inst., San Antonio, Tex. Engineering Analysis Section.
FUEL SLOSHING STUDIES Quarterly Progress Report No. 3
H. Norman Abramson, Luis R. Garza, and Daniel D. Kana 1 Jan. 1962 42 p refs
(Contract NAS8-1555; SwRI Proj. 1072-2)
(NASA-CR-76977) CFSTI: HC $2.00/MF $0.50 CSCL 21H

This report presentes the results of experiments conducted with sloshing liquids in cylindrical and spherical tanks during the period 1 October 1961 through 1 January 1962. Tests were performed to determine the effect of baffle location on the damping produced by a single fixed ring baffle in a cylindrical tank with constant liquid depth. Resulting forced vibration damping factors are compared with free vibration damping factors obtained by NASA. Experiments with spherical tanks were performed to determine total force response for bare wall and ring baffled tanks. The spherical tanks were excited both in translation and in pitching. Author

29 SPACE RADIATION

Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. For related information see also: 13 Geophysics; and 24 Physics, Atomic, Molecular, and Nuclear.

N66-31617# Naval Research Lab., Washington, D. C.
GALACTIC AND EXTRAGALACTIC X-RAY SOURCES
E. T. Byram, T. A. Chubb, and H. Friedman *In its* Rept. of NRL Progr. May 1966 p 5–8 (See N66-31615 18-23)

Evidence of two extragalactic X-ray sources, Cygnus A and M-87, was obtained from instruments carried aboard an Aerobee rocket which was launched April 26, 1965, from White Sands Missile Range. X-rays were also detected from the direction of the galactic supernova remnant Casiopeia A. Cygnus XR-1, which was observed on a previous flight, had decreased in brightness by 75 percent. Improved detection sensitivity made it possible to double the number of discrete X-ray sources previously detected. The X-ray luminosity of the extragalactic sources were one to two orders of magnitude greater than their radio and optical luminosities. Author

N66-31745*# Yale Univ. Observatory, New Haven, Conn.
[INVESTIGATIONS OF THE INTERACTION OF SOLAR FLARE PARTICLE WITH THE CORONAL PLASMA] Final Report
Ludwig Oster [1966] 8 p refs
(Grant NsG-176-61)
(NASA-CR-76457) CFSTI: HC $1.00/MF $0.50 CSCL 20H

A brief summary of the publications which originated from this research is presented. One study showed that a resonance at the electron plasma frequency is present which is of the general form required to explain the type III radio bursts from the sun. Quantitative applications showed that the observed intensities and half-widths of type III bursts can be understood by postulating the passage of quite reasonable numbers of fast particles. Brief additional comments are made concerning each of the 20 references which appear in the bibliography. H.S.W.

N66-31770*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SOME RESULTS FROM THE IMP-1 GM COSMIC RAY DETECTOR
V. K. Balasubrahmanyan, G. H. Ludwig, F. B. Mc Donald, and R. A. R. Palmeira Rio de Janeiro, Centro Brasileiro de Pesquisas Fis., 1964 21 p Presented at the CLARCFE Meeting, Buenos Aires, Aug. 1964 Notas de Fisica, Vol. XI, No. 12
(NASA-TM-X-57736) CFSTI: HC $1.00/MF $0.50

Results obtained with two mutually perpendicular GM telescopes on board the IMP-1 (Explorer XVIII) satellite are presented. It is shown that these results imply an anisotropic recovery of the cosmic ray intensity towards the maximum of the 11-year variation, the greatest modulation taking place in a direction close to the ecliptic poles. It is also shown that these results are consistent with the current views concerning the cavity that the solar wind produces in the inner solar system when it is slowed down and stopped by the galactic material. The omnidirectional intensity of particles with energy >40 Mev seems to suffer periodic fluctuations with period close to 12 hours. It is further shown that these fluctuations agree in amplitude and phase with similar fluctuations measured. This suggests the existence of a mechanism capable of producing a true time variation in the cosmic ray intensity as seen by the satellite detector, and this mechanism could also explain the semi-diurnal variation measured with ground detectors. Author

N66-31784# General Electric Co., Philadelphia, Pa. Missile and Space Div.
ON THE INTERNAL MAGNETIC FIELD OF THE SUN
K. T. Yen Jul. 1966 28 p refs
(R66SD39)

Analytical solutions for the internal magnetic field of the sun are presented. The solutions are based on the idea that the solar wind originates from the sun's interior. The magnetic field is assumed to be weak throughout the interior of the sun so that its effects on the general physical properties of the sun are small. The magnetogasdynamic equations are used to obtain the magnetic solutions. The general configuration of the magnetic lines given by the present solutions is found to be in agreement with that assumed by Babcock in his study of the sunspots and the 22-year solar cycle. A distinctive feature of the configuration is the presence of shallow submerged lines underneath the sun's surface. Author

N66-31897*# Naval School of Aviation Medicine, Pensacola, Fla.
FLARE HAZARDS AT SOLAR MINIMUM: DOSIMETRIC EVALUATION OF THE CLASS 2 FLARE OF FEBRUARY 5, 1965
Hermann J. Schaefer Jan. 1966 20 p refs Joint rept. with NASA
(NASA Order R-75)
(NASA-CR-76518; NAMI-970) CFSTI: HC $1.00/MF $0.50 CSCL 20H

The proton energy spectra for the Class 2 solar flare of February 5, 1965, as reported by a polar orbit satellite at five different times during the two-day period of enhanced intensity, are evaluated in terms of tissue depth doses for a semi-infinite slab with 0.1 g/cm^2 shielding and for the Gemini and Apollo shield distribution. Maximum dose rates for the tissue surface are 714 millirads/hour, P$_1$, and 11 millirads/hour, respectively. For the unidirectional beams, half value layers range from 2.6 to 5.6 millimeters of tissue. The integral flare dose over forty-four hours is 8.3 rads for the tissue surface behind 0.1 g/cm^2 shielding. Author

N66-32008*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ENHANCEMENT OF LIGHT OUTPUT FROM A SUPERNOVA
A. G. W. Cameron and S. A. Colgate (Calif. Univ., Berkeley; Lawrence Radiation Lab.) *In its* Publ. of Goddard Space Flight Center, 1963, Vol. I [1963] p 23-27 refs (See N66-32006 18-30) GPO: HC $9.75; CFSTI: MF $7.50

Some suggestions have been made to account for the large energy radiated by strong radio sources, i.e. 3C 273, and an investigation was conducted, within the framework of one of these theories, into a possible mechanism which may be able to account for the intense light flashes observed in 3C 273. The theory studied states that the collective formation of a cluster of more massive stars with similar evolutionary time scales, results in type II supernova explosions in a limited period of time. An analysis of this theory is provided and it is stated that this analysis indicates that much of the kinetic energy of a shock injected supernova envelope can be converted into visible light if a significant fraction of the envelope is slowed by collision with circumstellar gases. H.S.W.

N66-32023*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SATELLITE OBSERVATIONS OF COSMIC RADIO NOISE BELOW 10 Mc/s AT LOW LATITUDES
J. K. Alexander *In its* Publ. of Goddard Space Flight Center, 1963, Vol. I [1963] p 618-621 refs (See N66-32006 18-30) GPO: HC $9.75; CFSTI: MF $7.50

Measurements of cosmic radio noise at 3, 4, 8, and 9 Mc/s by the Alouette satellite for transits near Hawaii in November 1965, are discussed. The temperature spectral index for radiation averaged over a hemisphere centered at declination=+10° and right ascension=20^h is found to be −1.8± 0.3 in this frequency range. A correction for synchrotron emission from the artificial radiation belt is assumed, and the resultant cosmic noise spectrum is found to show considerable flattening below 10 Mc/s in agreement with other measurements. Author

N66-32026*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
LIFETIME AND TIME HISTORIES OF TRAPPED RADIATION BELT PARTICLES

Wilmot N. Hess *In its* Publ. of Goddard Space Flight Center, 1963. Vol. I [1963] p 973–986 refs (See N66-32006 18-30) GPO: HC $9.75; CFSTI: MF $7.50

Advances in understanding the lifetimes of trapped radiation belt particles are surveyed. The problem of particle lifetimes has been one of the most important and perplexing in radiation belt work for several years. As a result of the past year's work, a good deal more is known about the natural Van Allen radiation belt and also the characteristics of the artificial belts produced by high altitude nuclear explosions. This increased knowledge is based on both observations and calculations of the artificial belts and Van Allen belt. This better understanding of particle lifetimes is a substantial step forward in forming an overall picture of the radiation belt in that we now have a basis for selecting source and loss processes more realistically and therefore making better models of the belt. Electron lifetimes based on data collected from the high altitude explosions of the U.S. and U.S.S.R., and proton lifetimes in the Van Allen belt are also discussed. Author

N66-32027*# Maryland Univ., College Park. Dept. of Physics and Astronomy.

IMPULSIVE INJECTION OF ELECTRONS INTO THE EARTH'S INNER TRAPPING REGION FROM SOLAR COSMIC-RAY EVENTS

Mordehai Liwshitz and A. M. Lenchek *In* NASA. Goddard Space Flight Center Publ. of Goddard Space Flight Center, 1963. Vol. I [1963] p 1033–1040 refs (See N66-32006 18-30) GPO: HC $9.75; CFSTI: MF $7.50

(Grant AF-AFOSR-62-284)

The decay of albedo neutrons generated in the polar caps by solar high-energy-particle events provides an impulsive source of geomagnetically trapped electrons. The decay density due to slow albedo neutrons (which describe ballistic orbits above the atmosphere) can be calculated from simple kinematic considerations. At constant B the injection density exhibits a peak at intermediate L. At L=2 and B=22 gauss a typical large SHEP event deposits $\leq 3\times10^{-6}$ electron cm^{-3}. The flux from these electrons is $\sim10^{3}$ electrons cm^{-2} sec^{-1} in the intervals 0–780 kev. Because of the low efficiency for detecting these electrons, it appears that this process alone cannot account for the time variations seen in Explorer 7. Author

N66-32028*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

THEOREMS CONCERNING THE ALLOWED CONE OF COSMIC RADIATION

Ernest C. Ray *In its* Publ. of Goddard Space Flight Center, 1963. Vol. I [1963] p 1132–1137 refs (See N66-32006 18-30) GPO: HC $9.75; CFSTI: MF $7.50

A previous investigation of the cosmic ray shadow cone and low latitude main cone is extended to include the main cone at all higher latitudes. The results are embodied in two theorems which specify the nature of a boundary of a class of trajectories, one of which are forbidden. No numerical results are included. Author

N66-32029*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

ON COSMIC RAY CUTOFFS

Ernest C. Ray and Herbert H. Sauer (State Univ. of Iowa) *In its* Publ. of Goddard Space Flight Center, 1963. Vol. I [1963] p 1138–1142 refs (See N66-32006 18-30) GPO: HC $9.75; CFSTI: MF $7.50

A cosmic ray cutoff in the Störmer sense is defined for sufficiently high latitudes when the magnetic field becomes approximately axially symmetric, at great distances from the earth. It is shown that the cutoff, when so defined, is given by a simple function of Mc Ilwain's L parameter. Numerical comparisons are made with a previous computer study of cutoffs defined in the same way. The expression for cutoff in terms of L suggests that the cutoff in the direction of the magnetic field should be approximately constant along a line of force. This is shown numerically to be so at latitudes too low for the derivation of the L expression to hold, for a particular field model. Author

N66-32031*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

TRAPPED ELECTRON TIME HISTORIES FOR L=1.18 TO L=1.30

W. N. Hess, J. A. Welch, Jr., and R. L. Kaufmann (Air Force Special Weapons Center) *In its* Publ. of Goddard Space Flight Center, 1963. Vol. I [1963] p 1165–1181 refs (See N66-32006 18-30) GPO: HC $9.75; CFSTI: MF $7.50

Numerical integration of a Fokker-Planck equation including atmospheric scattering and energy loss has been used to predict the time decay of electrons injected into the geomagnetic field by the July 9, 1962, nuclear explosion over Johnston Island. Calculations were performed for L=1.18, 1.25, and 1.30 using an atmosphere characteristic of sunspot minimum and averaged over longitude, keeping L and B fixed. Deviations of the calculated and observed spatial distribution at one week after the injection are attributed to the overly simplified initial conditions. The early decay follows closely the form $\tau/(t+\tau)$ and is followed by an exponential decay at later times. For L=1.25, τ varies from 10^{4} sec at at B=0.21 to 10^{3} sec at B=0.16 (the equator). The exponential decay for L=1.25 has a mean life of 1.3×10^{3} seconds. Decay is accompanied by spectral hardening. After any substantial decay the spectrum is peaked at about 1.5 Mev. Author

N66-32059*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

A POSSIBLE METHOD OF CORRECTING LOW FREQUENCY RADIO OBSERVATIONS FOR IONOSPHERIC ABSORPTION

Larry W. Brown *In its* Publ. of Goddard Space Flight Center, 1963. Vol. II [1963] p 475–490 refs (See N66-32044 18-31) CFSTI: HC $7.00/MF $5.00

An on-site method of observationally correcting radio astronomical measurements for ionospheric absorption has been discussed. The method consists of observing two discrete radio sources as they approach and recede from a common zenith distance (in both time and angle). The observation requires an equatorially driven radio telescope with a resolution capable of observing several bright radio sources scattered over the sky. It is suggested that a swept-lobe interferometer be used at frequencies near 20 Mc/s and 40 Mc/s. Each antenna should have a gain of approximately 17 db and a separation of 1,500 feet. The noise figure of the receiver should be less than 4. The above experiment should be able to determine accurate ionospheric absorption corrections for low frequency radio astronomy. Author

N66-32061*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

DELINEATION OF TRACKS OF HEAVY COSMIC RAYS AND NUCLEAR PROCESSES WITHIN LARGE SILVER CHLORIDE CRYSTALS

Charles B. Childs and Lawrence M. Slifkin (North Carolina Univ.) *In its* Publ. of Goddard Space Flight Center, 1963, Vol. II [1963] p 506–512 refs Supported in part by AF and Army (See N66-32044 18-31) CFSTI: HC $7.00/MF $5.00

Tracks of energetic charged particles, such as heavy primary cosmic rays and the products of nuclear collisions, have been made visible within the interior of large, transparent crystals of silver chloride. The tracks are delineated by photoelectric formation of metallic silver along them. This technique may be useful as a convenient and distortion-free method for the study of heavy primaries and fission fragments. Author

N66-32206# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.

RADIATION SHIELDING CONSIDERATIONS FOR INTERPLANETARY SPACECRAFT

Carl F. Kottler, Jr. Jan. 1966 52 p refs (RE-236)

Presented is an analysis of the radiation dosage astronauts would receive when protected by various combinations of passive shielding, as a function of mission duration and the probability of exceeding the statistically predicted dosage of the NASA Model Solar Proton Environment. Dosages to the internal organs and the skin (taking into account self-shielding) are determined as a function of the energy of the incident particles, and are compared with permissible dosages. The shielding and associated effective cutoff energies required for protection against alpha particles and protons are calculated for mission durations between 1 week and 2 years, with three probabilities of exceeding the indicated dosages (0.1, 0.01, and 0.001). The data permits comparison between magnetic or electrostatic shielding and passive shielding on the basis of radiation dosage and emission duration. Parametric curves for typical aluminum structure, polyethylene shield, hydrogen fueled spacecraft are shown. An introductory description of the solar atmosphere, solar activity, and associated geomagnetic phenomena is also presented along with reference tables. Author

N66-32272*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

THE GENERAL FOKKER–PLANCK EQUATION FOR TRAPPED ELECTRON DIFFUSION

J. G. Roederer (NAS-NRC) and J. A. Welch (AFSC) *In its* Goddard Space Flight Center Contrib. to the COSPAR Meeting, May 1965 Jul. 1966 p 183–207 refs (See N66-32266 18-30) CFSTI: HC $7.00/MF $1.50

A general Fokker–Planck equation is deduced which describes the distribution of geomagnetically trapped electrons as a function of longitude, time, energy, and mirror point field intensity. A special variable for the longitudinal position of a particle is introduced. The physical interpretation of this equation is analyzed for several special cases. In particular, it is found that the usual procedure of averaging over longitude in order to obtain a longitude-independent equation is not valid for the description of electrons mirroring at low altitudes. In that case, the longitude dependence cannot be averaged out and a four-dimensional equation must be used. Author

N66-32273*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

THE NEUTRON FLUX IN SPACE FOLLOWING A POLAR CAP NEUTRON EVENT ON NOVEMBER 15, 1960

W. N. Hess, E. L. Chupp (New Hampshire Univ.), and C. Curry (California Univ.) *In its* Goddard Space Flight Center Contrib. to the COSPAR Meeting, May 1965 Jul. 1966 p 209–220 refs (See N66-32266 18-30) CFSTI: HC $7.00/MF $1.50

A neutron detector flown on an Atlas pod during the 15 November 1960 solar event measured a larger neutron flux than another detector flown on a similar vehicle during a quiet solar period. The excess neutron flux at low latitudes obtained by comparing these two measurements is about an order of magnitude higher than expected from the neutron production in the atmosphere by solar protons as deduced from Lingenfelter's calculations and Webber's model for the 15 November event. It is suggested that most of the discrepancy can be accounted for by considering neutron production by energetic solar alpha particles and lowered geomagnetic cutoffs. Author

N66-32528# Kyoto Univ. (Japan).

THERMAL STABILITY OF THE CHROMOSPHERE AND SPICULE

Shotaro Miyamoto 1965 14 p refs Contrib. from Inst. of Astrophysics and Kwasan Obs. No. 139

Thermal stability of the chromosphere and corona was considered under the assumption that the energy input and output are transformation of mechanical energies into heat and radiative emissions respectively. The rise of temperature from chromosphere to corona is almost discontinuous, and both chromospheric and coronal states are thermally stable. However, in the upper chromosphere, there appears a possibility of coexistence of both states. Spicule model of the upper chromosphere is in harmony with our thermal consideration. At the boundary of chromosphere and corona, three conditions must be satisfied: Static condition of dynamics requires the equality of pressures, from chromospheric and coronal sides. Thermal condition proves that the chromosphere cannot be steady without corona above certain height. On the other hand, the condition of continuity of matter, namely, net material flux across the boundary does not vanish in static and uniform stratification. Net flux is dominantly from corona to chromosphere. Henceforth, non-uniform upward stream such as spicule is requested in order to cancel the net material flux and prevent corona from collapse, which will induce the thermal instability of the upper chromosphere. Spicule phenomena seem inevitable to satisfy three conditions mentioned above and to keep the stratification steady. Author

N66-32564# Kyoto Univ. (Japan).

THE EFFECT OF ULTRAVIOLET RADIATION ON THE IONIZATION AND EXCITATION OF MATTER IN PROMINENCES. II: CONTINUOUS SPECTRA

Ichiro Kawaguchi 1965 16 p refs Contrib. from Inst. of Astrophysics and Kwasan Obs. No. 144

CFSTI: HC $1.00/MF $0.50

Given the electron density, temperature and the intensities of Lyman continuous and Lyman alpha radiation incident upon prominences, the ionization of hydrogen atoms and the excitation of the second energy level are obtained as a function of optical depth. Using a simplified model in which a prominence is stratified into two zones, it is shown that the observed Balmer and Paschen jump can be explained in terms of a low temperature 6000°–8000°K and an electron density $N_e = 5.10^{10}$ cm^{-3}. Based on the observed brightness, a possible structure of prominences is discussed. Author

N66-32576# Chicago Univ., Ill. Enrico Fermi Inst. for Nuclear Studies.

THE PROPAGATION OF HIGH ENERGY NUCLEONS THROUGH THE ATMOSPHERE AND THE GENERATION OF MESONS

Yu. A. Smorodin [1965] 31 p refs Presented at the Astrophysical Sem., Univ. of Chicago, May 1965

An analysis of experimental data on the atmospheric passage of nucleons in the energy range 10^{12}–10^{14} eV is presented. The average integral characteristics of the interaction of nucleons in this range are obtained. The measured value in the nucleon studies is the energy of the electron photon cascade initiated by particles created in nuclear interactions. Measurements of the cascade were carried out by recording large ionization bursts originating in the multiplication of an avalanche in a lead filter of proper thickness. The mean free path for interaction of nucleons with energy at about 10^{12} eV was measured by using the method of subtraction from the beam. The mean free path for inelastic interactions of nucleons of 10^{12} eV in carbon is close to 90 gr/cm^2. It was determined that the spectra of the nuclear-active component are power type, and that the absorption of the nuclear-active component in the atmosphere is nearly exponential. The production spectrum of gamma rays in the atmosphere was determined. The equal rates of production of mesons in the atmosphere was confirmed within the uncertainty of about 30%. E.A.O.

30 SPACE SCIENCES

Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbit and trajectory. For related information see also: 11 Facilities, Research and Support; and 31 Space Vehicles.

N66-31418# Boeing Scientific Research Labs., Seattle, Wash. Mathematics Research Lab.

A CONTOUR MAP BASED ON THE SELENODETIC CONTROL SYSTEM OF THE AERONAUTICAL CHART AND INFORMATION CENTER OF THE U.S. AIR FORCE

T. A. Bray and C. L. Goudas Mar. 1966 20 p refs *Its* Math. Note No. 457

(DI-82-0518; AD-633031) CFSTI: HC $1.00/MF $0.50

The control system published in 1965 by the Aeronautical Chart and Information Center (ACIC) has recently been augmented by more than one hundred points, thus making it necessary to perform an analysis of the new enlarged system and construct the corresponding contour map which we present in this paper. This new map exhibits substantial consistence with the one constructed from only the 196 points of the original system, and appears to represent a stronger solution. Author (TAB)

N66-31446*# California Inst. of Tech., Pasadena.

PROCEEDINGS OF THE CALTECH–JPL LUNAR AND PLANETARY CONFERENCE

Harrison Brown, Gordon J. Stanley, Duane O. Muhleman, and Guido Muench, ed. 15 Jun. 1966 357 p refs Conf. held at Calif. Inst. of Tech., Pasadena, 13–18 Sep. 1965 Prepared jointly with JPL

(Contract NSR-05-002-050)

(NASA-CR-76142; JPL-TM-33-266) CFSTI: HC $7.00/MF $1.75 CSCL 03B

Conference papers on lunar and planetary studies for Mars, Jupiter, and Venus are presented. For individual titles see N66-31447–N66-31481.

N66-31447*# California Univ., La Jolla.

OBSERVATIONS ON THE RANGER VIII AND IX PICTURES

Harold C. Urey *In* Calif. Inst. of Tech. Proc. of the Caltech–JPL Lunar and Planetary Conf. 15 Jun. 1966 p 1–23 refs (See N66-31446 18-30) CFSTI: HC $7.00/MF $1.75

Areas of the lunar surface photographed by camera aboard the Ranger VIII and IX probes are pictured and commented upon. Surface features, such as the nature, distribution, and location of craters and dimples, are used to speculate upon the history of the formation of the surface. Surface density, smooth and rough features, ridges, mountains, and sea areas are discussed. A summary of observations on the Ranger VII photographic series is also made. L.S.

N66-31448*# Arizona Univ., Tucson. Lunar and Planetary Lab.

INTERPRETATION OF THE RANGER RECORDS

Gerard P. Kuiper *In* Calif. Inst. of Tech. Proc. of the Caltech–JPL Lunar and Planetary Conf. 15 Jun. 1966 p 24–29 refs (See N66-31446 18-30) CFSTI: HC $7.00/MF $1.75

Records obtained by the Ranger VII, VIII, and IX are interpreted with a view toward answering some basic questions about the nature of the lunar surface. The nature of the mare surface; the existence of major lava flows on the maria (their deposition, solidification, and cooling); the volcanic vents associated with lava channels; the rilles, domes, lineaments, tree-bark structure on the maria; and the many outcroppings are discussed. Also discussed are the primary crater counts; the crater ray deposit fields; the crater ridges; and other lunar surface features. L.S.

N66-31449*# Geological Survey, Flagstaff, Ariz.

PROGRESS IN THE ANALYSIS OF THE FINE STRUCTURE AND GEOLOGY OF THE LUNAR SURFACE FROM THE RANGER VIII AND IX PHOTOGRAPHS

Eugene M. Shoemaker *In* Calif. Inst. of Tech. Proc. of the Caltech–JPL Lunar and Planetary Conf. 15 Jun. 1966 p 30–31 (See N66-31446 18-30) CFSTI: HC $7.00/MF $1.75

A report on the progress in reduction and synthesis of the data obtained from the Ranger VIII and IX missions is presented. The photographic data is being used to analyze the fine structure and geology of the lunar surface. The pictures should provide the best material for photogrammetric measurement of the shape of small features on the moon among all of the photographs obtained from the entire Ranger series (with Ranger VII). With the Ranger VIII and IX pictures it is possible to map the geology of selected areas from the photographs at many different scales, ranging from 1:1,000,000 (the scale used in the earth-based telescopic mapping program) up to about 1:10,000 (a scale typically employed for highly detailed geologic mapping on earth). The data should also provide the basis for preliminary planning and evaluation of scientific tasks that may be successfully executed by astronauts in the early landings on the moon of Project Apollo. L.S.

N66-31450*# California Inst. of Tech., Pasadena.

CURRENT PROBLEMS IN THE INTERPRETATION OF LUNAR PHYSICAL OBSERVATIONS

Bruce C. Murray *In its* Proc. of the Caltech–JPL Lunar and Planetary Conf. 15 Jun. 1966 p 32–33 (See N66-31996 18-30) CFSTI: HC $7.00/MF $1.75

A summary of a report on some inconsistencies in the interpretation of some lunar physical observations is presented. The apparent contradiction between infrared results and those to be expected on the basis of a theoretical model by V.S. Troitsky and others is considered. The model is based pri-

marily on an interpretation of precise observations of the integral brightness of the moon at radio wavelengths. The 100°K (or lower) midnight temperature on the lunar surface reported from the infrared observations is incompatible with the mean radio temperature averaged over the disk of 207± 2°K used by Troitsky to infer physical parameters of the lunar surface. The discrepancies between infrared and radio data are discussed in further detail. The study may lead to methods of indicating significant differences in resolutions corresponding to high and low surfaces of the moon. L.S.

N66-31451*# Scientific Inst. of Radiophysics, Gorky (USSR).
INVESTIGATION OF THE SURFACES OF THE MOON AND PLANETS BY THE THERMAL RADIATION
V. S. Troitsky *In* Calif. Inst. of Tech. Proc. of the Caltech–JPL Lunar and Planetary Conf. 15 Jun. 1966 p 34–58 refs (See N66-31446 18-30) CFSTI: HC $7.00/MF $1.75

Experimental and theoretical thermal radiation and radio emission data concerned with the lunar and planetary surfaces are summarized. Mathematical expressions involving the dielectric constants and densities of materials, thermal regimes and parameters; surface radio emission; surface temperatures and temperature gradient to the depth and heat flux out of the body interior; integral radio emission, surface radio emission at the nonperiodic thermal regime (lunar eclipse); surface material microstructure; and chemical (mineralogical nature) composition of surfaces, are presented and discussed. Tabulated data of numerical values of the Fourier expansion terms for surface temperatures in the center of the lunar disk; and of radio emissions of the moon during lunations and eclipse are given. Also discussed is the absorption spectrum of electromagnetic waves in the lunar surface and underlying body, and the results of some radar data regarding the properties of the Venus surface. L.S.

N66-31452*# Scientific Inst. of Radiophysics, Gorky (USSR).
SOME REMARKS ON NEW MEASUREMENTS OF LUNAR TEMPERATURE AT THE ANTISOLAR POINT
V. S. Troitsky *In* Calif. Inst. of Tech. Proc. of the Caltech-JPL Lunar and Planetary Conf. 15 Jun. 1966 p 59–60 (See N66-31446 18-30) CFSTI: HC $7.00/MF $1.75

The contradiction of a new value of midnight temperature of the lunar surface, $T_{sn} \simeq 100°$ K with the results of precision measurements of the constant component of the mean disk radio temperature of the moon $\overline{T}_e$ is discussed. The contradiction is important for all considerations about the parameters of the upper layer of the moon, and if confirmed, may lead to reconsideration of data obtained. It is suggested that perhaps the roughness of the lunar surface may have influenced the accuracy of the lunar infrared night temperature distribution, thereby making the precision of these measurements inferior to that of the radio measurements. L.S.

N66-31453*# Academy of Sciences (USSR), Moscow. Schmidt Inst. of Physics of the Earth.
THE STRUCTURE OF THE MOON
B. J. Levin *In* Calif. Inst. of Tech. Proc. of the Caltech–JPL Lunar and Planetary Conf. 15 Jun. 1966 p 61–76 refs (See N66-31446 18-30) CFSTI: HC $7.00/MF $1.75

Theories, calculations, and data concerning: (1) the origin of the moon and the tidal evolution of the earth–moon system, (2) the history of lunar bombardment, (3) the lunar thermal history, (4) the shape of the moon, (5) density distribution of the lunar body and crust, (6) the chemical composition of lunar material (the question of frozen and nonfrozen volatiles and of hydrated silicates is submitted), and (7) the history of the lunar atmosphere, as put together from the literature, are presented and discussed. L.S.

N66-31454*# California Univ., Los Angeles.
ON THE INTERNAL CONSTITUTION AND ORIGIN OF THE MOON
Gordon J. F. Mac Donald *In* Calif. Inst. of Tech. Proc. of the Caltech-JPL Lunar and Planetary Conf. 15 Jun. 1966 p 77–83 refs (See N66-32446 18-30) CFSTI: HC $8.00/MF $1.75

Data on the orbital and rotational motion of the lunar body; the mass and mean density of the moon; interpretation of the moon's moment of inertia; thermal constitution and distribution considerations; and other evidence, are used to draw inferences regarding the internal structure of the moon. Evidence on hand seems to support the view of an inhomogeneous, nondifferentiated moon. The relevance of dynamical arguments to the question of how the moon may have formed is considered, and a model of formation is suggested. With further data (such as seismic observations and determination of the lunar gravitational field) it is expected that more sophisticated models will be made. L.S.

N66-31455*# California Inst. of Tech., Pasadena.
THE INTERNAL STRUCTURE OF THE MOON AND THE TERRESTRIAL PLANETS
Don L. Anderson and Robert L. Kovach (Stanford Univ.) *In its* Proc. of the Caltech-JPL Lunar and Planetary Conf. 15 Jun. 1966 p 84–91 (See N66-31446 18-30) CFSTI: HC $7.00/MF $1.75

The hypothesis that differences in the mean densities of the terrestrial planets account for inhomogeneity in this part of solar system is re-examined in the light of new information regarding the distribution of density in the interior of the Earth. The iron in Mars may be more evenly distributed than in Earth, but Mars may still not differ from the Earth in overall composition. It is possible to design models for Mars and Venus that have the same uncompressed density as the Earth and that satisfy the available data concerning these planets, without assuming that the Earth's core is a phase change of the silicate mantle. Thermal history calculations for computing the densities of planetary bodies with depth, and which show whether the body is differentiated or not, are presented and discussed. An equation of state that is appropriate for the Earth predicts a density decreasing with depth in the lunar interior, thereby giving a high moment of inertia. Seismic travel-time curves ad periods of free oscillation were also computed for the moon model. Several graphs depicting the calculations described, are included. L.S.

N66-31456*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
LUNAR STRUCTURE AS DEDUCED FROM MUONG NONG TEKTITES
J. A. O'Keefe and I. Adler *In* Calif. Inst. of Tech. Proc. of the Caltech-JPL Lunar and Planetary Conf. 15 Jun. 1966 p 92–101 refs (See N66-31446 18-30) CFSTI: HC $7.00/MF $1.75

The Muong Nong tektites, found chiefly in Thailand and Indo-China, are discussed with respect to the morphology and structure of lunar craters. These tektites have characteristic structures similar to those seen in most tektites, but the Muong material structure is arranged in parallel layers and is accompanied by a shimmering appearance within each layer. Chemical analysis shows them to be almost identical with splash-form tektite types which, when examined as whole bodies between crossed nicols, show a pattern of strain birefringence. This indicates that splash-form types cooled as a unit; however no such overall strain pattern is associated with the Muong material. This suggests that Muong tektites, gener-

ally found in large associations, are more primitive than other types. Angular voids (spaces between grains) in the crystalline structure imply that these tektites were never thoroughly mixed. Various data and microphotograph studies are discussed which lead to the conclusion that the Muong material was glass or finely crystalline before impact with earth took place. This implies that the impact took place in space. As these tektites are found inbedded in lunar surface material formed by natural volcanic ash, the findings can be applied to studying lunar crater structures. L.S.

N66-31457*# Maryland Univ., College Park.
RECENT RADIO OBSERVATIONS OF JUPITER
Max M. Komesaroff *In* Calif. Inst. of Tech. Proc. of the Caltech-JPL Lunar and Planetary Conf. 15 Jun. 1966 p 107–116 refs (See N66-31446 18-30) CFSTI: HC $7.00/MF $1.75

Observations of Jupiter at radio emission frequencies below 40 Mc/sec and above 200 Mc/sec are discussed. In the decameter wavelength range the radiation is sporadic, elliptically polarized, and frequently extremely intense. The radiation source is considerably smaller in angular size than the planetary disk. By contrast, from about 200 Mc/sec to several thousand megacycles, the nonthermal intensity component is steady and amounts to only a few flux units. The predominant polarization is linear, and the radio source is several times more extended than the planet. The decameter radiation is discussed with respect to the time variations (dependency on System III longitude and short period fluctuation); radio link interferometric source size measurements; spectral characteristic studies; elliptical polarization evidence for support of the theory that the magnetic fields are connected with the radiation process; and to evidence showing correlations of the Jupiter emission with solar activity and with the planets innermost satellite Io relative to the Earth-Jupiter line. Spectral observations; polarization studies (linear and circular); and variations of activity are also discussed for the decimeter radiation. Data graphs pertinent to the discussions are depicted; and comments on the data are made. L.S.

N66-31458*# California Inst. of Tech., Pasadena.
INTERFEROMETRY OF JUPITER IN THE DECIMETER RANGE
Glenn L. Berge *In its* Proc. of the Caltech-JPL Lunar and Planetary Conf. 15 Jun. 1966 p 117–121 refs (See N66-31446 18-30) CFSTI: HC $7.00/MF $1.75

The results of long-baseline, high resolution, interferometric measurements (at 10.4 and 21.2 cm) of Jupiter radio source behavior are discussed and analyzed. The interferometer was uniquely capable of resolving the small integrated source behavior of the planet in the decimeter-wavelength region. The planes of polarization across the source; the distribution of the emission; visibility functions; polarization properties; and information regarding the size of the source are discussed. Graphs and contour depictions of the data are given. L.S.

N66-31459*# Colorado Univ., Boulder.
THEORY OF THE JOVIAN STRUCTURE
James W. Warwick *In* Calif. Inst. of Tech. Proc. of the Caltech-JPL Lunar and Planetary Conf. 15 Jun. 1966 p 122–127 (See N66-31446 18-30) CFSTI: HC $7.00/MF $1.75

An appraisal of the quality of the largely heterogeneous facts available about Jupiter's radio phenomena is presented in an effort to determine a truer picture of the Jovian magnetic field structure. Decimetric radio emission is referred to as DIM, and decametric radio emission is referred to as DAM. The flux, shape, generation, particle trapping capability, dipole moments, lines of force, rotation variation, and bursts of the planet's magnetic field are discussed; and a speculative model regarding the magnetic field is presented. L.S.

N66-31460*# Florida Univ., Gainesville.
JOVIAN ROTATION PERIODS AND THE ORIGIN OF THE DECAMETRIC BURST STRUCTURE
Alex C. Smith, G. R. Lebo, C. N. Olsson, W. R. Block, N. F. Six et al *In* Calif. Inst. of Tech. Proc. of the Caltech-JPL Lunar and Planetary Conf. 15 Jun. 1966 p 128–133 refs Sponsored by NSF, Army, ONR, and NASA (See N66-31446 18-30) CFSTI: HC $7.00/MF $1.75

Plots showing movements of the Great Red Spot of Jupiter (long term oscillation, short term acceleration, and recent changes) are used to determine more accurately the Jovian rotation periods; and comparisons of the Red Spot drift with the drift of the principal radio source from Jupiter are made in an effort to determine the origin of the burst structure in the Jovian decametric radiation. These and other comparisons seem to suggest that Jovian pulse character is not determined by the same factors that control the scintillation of satellite and radio star signals. On the assumption that the pulses originate at Jupiter, an effort is being made to determine the electron density of the intervening interplanetary medium by measuring the delay in arrival time between two frequencies 200 kc apart at 18 Mc/sec. The initial result of 23 electrons/cm^3 is clearly high in comparison with other methods. It is suggested that a substantial part of this dispersion occurs as the radiation escapes along ion ducts in the Jovian magnetosphere. L.S.

N66-31461*# Colorado Univ., Boulder.
THE EFFECT OF IO ON THE RADIO EMISSION OF JUPITER
George A. Dulk *In* Calif. Inst. of Tech. Proc. of the Caltech-JPL Lunar and Planetary Conf. 15 Jun. 1966 p 34–36 (See N66-31446 18-30) CFSTI: HC $7.00/MF $1.75

The sequence of the radio emission from Jupiter as the planet rotates, and details of the geometry and spectrum of the emission pattern, are given as background material for a discussion of how the Jupiter satellite Io affects the emission. Some means by which Io might influence the emission are as follows: (1) Io distorts Jupiter's field lines in its vicinity, thus disturbing the orbits of particles trapped on these field lines and causing them to precipitate into Jupiter's ionosphere or atmosphere where they generate radio emission; (2) shock waves emanate from Io and disturb trapped particle orbits in regions remote from Io; (3) tidal effects from Io; (4) the acceleration of particles in Io's path, rather than their disturbance; and (5) the existence of an electric field between Io and Jupiter, which could accelerate particles as they travel along field lines betwen the bodies. Several parameters important to the discussion are listed. L.S.

N66-31462*# California Inst. of Tech., Pasadena.
COMMENTS ON THE DISCUSSION OF JUPITER
Leverett Davis, Jr. *In its* Proc. of the Caltech-JPL Lunar and Planetary Conf. 15 Jun. 1966 p 137–140 (See N66-31446 18-30) CFSTI: HC $7.00/MF $1.75
(Grant NsG-426)

This discussions of some other speakers concerning radio emission from the planet Jupiter, are commented upon. Discussed are the influence of the satellite Io on the decametric radiation of Jupiter, the geometry of the planetary magnetic field, and other inter-relationships of the magnetic field and radio emission. L.S.

N66-31463*# Johns Hopkins Univ., Baltimore, Md.
BALLOON TELESCOPE STUDIES OF VENUS
John Strong *In* Calif. Inst. of Tech. Proc. of the Caltech–JPL Lunar and Planetary Conf. 15 Jun. 1966 p 147–150 refs (See N66-31446 18-30) CFSTI: HC $7.00/MF $1.75

The amount of water vapor, and the existence of ice clouds in the atmosphere of Venus were determined by telescopic and spectrometric instruments suspended from balloons over the Earth at an altitude that was above 99.9% of the Earth's water vapor and 97% of the Earth's CO_2. Radiation was measured in the band at 1.13μ, with a grating spectrometer of 2 A resolving power once every 10 sec with a set of exit slits arrayed to match water absorption line groups. The radiation passing through was received by a chilled photomultiplier and its response was recorded on paper. A low dispersion grating, utilizing three detectors in place of the slits, was used for the ice cloud experiments. Details of the measured data are given. The influence of the doppler shift on the recorded data was also measured. The existence of water vapor and ice clouds on Venus explained the observations that the temperature of the shady side of the planet does not fall more than a few degrees short of the temperature of the sunny side as measured in the 8 to 14μ band, even though the shady side has several months to cool off. The failure to cool may be due to the liberation of latent heat of water vapor of about 620 cal/gm, as that vapor condenses to form clouds. The results also bear on the radio emissions from Venus. L.S.

N66-31464*# RAND Corp., Santa Monica, Calif.
COMMENTS ON THE DETECTION OF WATER AND ICE CLOUDS ON VENUS
Diran Deirmendsian *In* Calif. Inst of Tech. Proc. of the Caltech–JPL Lunar and Planetary Conf. 15 Jun. 1966 p 150–154 refs (See N66-31446 18-30) CFSTI: HC $7.00/MF $1.75

The detection of water and ice clouds on Venus by Strong and his collaborators is commented upon. Comparison of terrestrial and Venusian reflected spectra lead to the tentative conclusion that the latter represent infrared sunlight diffusively reflected by a dense, unbroken Venusian ice cloud. The formation of absorption bands by scattering alone, and on cloud scattering in general are discussed with reference to water or ice particles. An experiment for detecting the glory that should be seen through an upper, optically dense, and unbroken ice cloud is proposed for verification of the Strong findings. If the visible spectrum is used, the chances would be small; but choosing a narrow region (λ1.6μ or λ2.25μ) where neither vapor nor liquid water has significant absorption bands should increase the chances of detecting the infrared glory, particularly in regions and at times of thinning of the Venusian ice cloud. Other comments on the clouds with respect to particulate and gaseous components are also made. L.S.

N66-31465*# Smithsonian Astrophysical Observatory, Cambridge, Mass.
PROPERTIES OF THE CLOUDS OF VENUS
Carl Sagan and James B. Pollack *In* Calif. Inst. of Tech. Proc. of the Caltech–JPL Lunar and Planetary Conf. 15 Jun. 1966 p 155–163 refs (See N66-31466 18-30) CFSTI: HC $7.00/MF $1.75

A method for calculating the fraction of monochromatic radiation reflected, transmitted, and absorbed by a layer of dispersed particles having arbitrary characteristics fluxes is described; and the method is applied to an examination of the clouds of Venus. The equation of radiative transfer for monochromatic radiation nonconservatively and anisotropically scattered by a dispersed medium is given, and rewritten in an approximation form which preserves anisottopies in flux. The approximate solutions for the fluxes are compared with exact solutions for a variety of limiting and special cases, and with laboratory results; and are presented in a table. The comparisons show the approximation formulae to be accurate to 5–10% in absolute value, and a few percent in relative value. Also tabulated are comparisons of the theoretical and observed values of the albedo of Venus. Curves comparing the theoretical and observed normalized infrared reflectivities of Venus for particle radii 1–20 and τ_1=18, and for particle radii 1–20 and τ_1=43 are depicted (τ=interaction optical depth). The influence of the size and composition of cloud particle size on the reflection spectrum is discussed. The mutual agreement of the results supports the identification of ice as the principal constituent of the clouds of Venus. L.S.

N66-31466*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
VENUS RADAR INVESTIGATIONS
Duane O. Muhleman *In* Calif. Inst. of Tech. Proc. of the Caltech-JPL Lunar and Planetary Conf. 15 Jun. 1966 p 164–171 refs (See N66-31446 18-30) CFSTI: HC $7.00/MF $1.75

Radar echo data concerning the motion and rotation of Venus, its surface scattering properties, and the nature of the surface material itself are reviewed. Echoes obtained from 1961 through 1965 are used for calculating the astronomical unit more precisely. Fundamental concepts upon which planetary radar techniques are based, are explained (e.g. the obtaining of doppler range maps by the simultaneous measurement of CW spectrum and pulse response). Published values of the power reflectivity (ratio of CW power received from the planet to the power that would be received from an equivalent smooth conducting sphere with the same geometry) of Venus at various wavelengths are presented in a table, and part of the data is plotted. A curve showing the comparison of an early Venus spectrum with a lunar spectrum taken with the same radar equipment is given. Other curves are depicted for: (1) typical Venus doppler-range gated spectra showing the spectra at increasing range depths; (2) a typical observed Venus spectrum with a scattering law model, and a 43-cm pulse repsonse with the same model; and (3) Venus backscatter functions measured at various wavelengths. A preliminary radar map of Venus showing the regions of anomalous reflectivity (alpha and beta regions) at 12.5-cm wavelength is also presented. L.S.

N66-31467*# Arecibo Ionospheric Observatory, (Puerto Rico).
SOME RADAR CHARACTERISTICS OF VENUS AT 430 MHz
R. B. Dyce *In* Calif. Inst. of Tech. Proc. of the Caltech-JPL Lunar and Planetary Conf. 15 Jun. 1966 p 172–177 refs Sponsored by ARPA and AFOSR (See N66-31446 18-30) CFSTI: HC $7.00/MF $1.75

Radar observations of Venus, using a 1000-ft-D reflector and a pulsed 430-MHz radar system, are described. The antenna was continusouly directed at the apparent position of the planet for periods of time that depend upon the declination. A train of coherent pulses was transmitted for a duration of time equal to the round trip delay, the transmitter was then stopped, and the receiver turned on for a corresponding period of time. The echo was sampled with respect to a time base moved so as to follow the ephemeris position of the planet to an accuracy of a few microseconds. Range and frequency information were obtained. A table of characteristics of the radar used is given. Measurements indicated that Venus has a significant-

ly higher reflectivity than that of the moon (which is about 7%). The Venus reflectivity data are plotted. Frequency data obtained confirm evidence previously cited for the Alpha and Beta regions which drift across the planetary and whose longitude and latitude can be deduced from the changing frequency of each feature. Data also confirm previous results by Goldstein which gave a retrograde rotation of 248 days for the planet. A contour plot of echo strength measured as a function of range and doppler frequency shift is given. L.S.

N66-31468*# Manchester Univ., Macclesfield (England). Nuffield Radio Astronomy Labs.

RADIO OBSERVATIONS OF VENUS AT JODRELL BANK

J. H. Thomson *In* Calif. Inst. of Tech. Proc. of the Caltech-JPL Lunar and Planetary Conf. 15 Jun. 1966 p 178–179 refs (See N66-31446 18-30) CFSTI: HC $7.00/MF $1.75

A summary of radar observations made at Jodrell Bank during close approaches of Venus in 1959, 1961, 1962, and 1964 are described. Two separate systems, pulse and CW, both with the 250-ft Mk I radio telescope as transmitting and receiving aerial, were used to obtain the echo data. The parameters of both systems are given in a table. The 1964 measurements with the CW system confirmed the retrograde motion of the planet and indicated a period of between 100 and 300 days. The other measurements are also briefly discussed. L.S.

N66-31469*# Cornell Univ., Ithaca, N. Y.

RECENT RADIO OBSERVATIONS OF THE PLANET VENUS

F. D. Drake *In* Calif. Inst. of Tech. Proc. of the Caltech-JPL Lunar and Planetary Conf. 15 Jun. 1966 p 180–183 refs (See N66-31446 18-30) CFSTI: HC $7.00/MF $1.75

Radio spectral data of Venus are depicted graphically, and are discussed. The effects of finding abundant water vapor in the planetary atmosphere on models of Venus are discussed; and an additional plot of the Venus radio spectrum in the vicinity of the 135-cm water vapor line is given. Also discussed are the measurements of the polarized brightness distribution of the decimeter radio emission which allow a more accurate picture of the temperature distribution over the disk, the size of the radio disk, and the orientation of the rotational pole of the planet. The measurements are the strongest evidence fo far gathered that the observed radio emission is actually emitted from the planetary surface. This strongly implies that the very high observed disk brightness temperatures are close to the surface thermometric temperature. All models of Venus must take into account this high temperature. The polarized brightness distribution also indicates that the dielectric constant of the surface is 2.5, suggesting that Venus is covered in the main by loose material. In addition, phase effect data and Venus atmosphere and surface model studies that fit the known data, are briefly reviewed. L.S.

N66-31470*# Academy of Sciences (USSR), Moscow. P. N. Lebedev Physical Inst.

SOME REMARKS CONCERNING THE RADIOASTRONOMICAL OBSERVATIONS OF VENUS

A. D. Kuzmin *In* Calif. Inst. of Tech. Proc. of the Caltech-JPL Lunar and Planetary Conf. 15 Jun. 1966 p 184–186 refs (See N66-31446 18-30) CFSTI: HC $7.00/MF $1.75

Theoretical and experimental data curves for an aerosol model are depicted, and discussed with a view toward explaining astronomical results reported in the spectra of Venus by absorption of aerosols from the Venus atmosphere. It is shown that the radio astronomical data may be satisfied by aerosols containing polar liquid dielectric if the relaxation time of the dielectric is equal to 1.5×10^{-12} to 5×10^{-12} sec. About 0.1 to 0.2 g/cm^2 of such an aerosol is needed to obtain cloud heights high enough to fit the model. Substances that satisfy the data for the model can be found in literature reference books. The data are satisfied for example by some types of hydrocarbons such as CH_3OH, C_6H_5Cl, etc., and by supercooled water. In addition, calculated curves for electron temperatures of 400°K and 300°K, together with plotted experimental results are depicted, in support of an explanation of long wavelength emissions from the Venus ionosphere. Also discussed are phase variations of the planet with respect to its brightness temperature. L.S.

N66-31471*# Paris Observatory, Meudon (France).

CONTRIBUTION TO THE CALTECH–JPL COLLOQUIUM ON THE MOON AND THE PLANETS: VENUS [CONTRIBUTION AU COLLOQUE CALTECH–JPL SUR LA LUNE ET LES PLANETES: VENUS]

Audouin Dollfus *In* Calif. Inst. of Tech. Proc. of the Caltech-JPL Lunar and Planetary Conf. 15 Jun. 1966 p 187–202 refs In FRENCH (See N66-31446 18-30) CFSTI: HC $7.00/MF $1.75

A general review is presented of data on Venus given at the lunar and planetary conference. The 1959 balloon work of Dollfus is summarized in which 70 μ of water vapor above the Venus clouds is reported, as are many photometric and polarimetric observations. The photometric data are shown to match the responses of a Venus atmosphere with a scale height of 2.8 km, a grain size of 2 μ, and a number density on the order of 3×10^8 cm^{-3}. Variations in the polarization of reflected light suggest the presence of water clouds as opposed to dust clouds. In addition to the detection of water content, the study of aerosols in the upper atmosphere of Venus is discussed. Consideration is also given to atmospheric pressure in the upper layer of clouds, the polarimetric study of the nature of clouds, and deviations in the direction of polarized light. Transl. by M.W.R.

N66-31472*# California Univ., Berkeley.

THE ATMOSPHERE AND SURFACE OF MARS—A SELECTIVE REVIEW

D. G. Rea *In* Calif. Inst. of Tech. Proc. of the Caltech–JPL Lunar and Planetary Conf. 15 Jun. 1966 p 209–238 refs (See N66-31446 18-30) CFSTI: HC $7.00/MF $1.75

A summary review of published reports pertaining to the atmosphere and surface of Mars is presented to construct a framework from which subsequent papers can be related. Some important physical properties of Mars and Earth are summarized in a table. Important properties of the Martian atmosphere, such as pressure, composition, and particulate content, as well as the presence of clouds, are discussed with accompanying data curves. The CO_2 spectral band of Mars is considered. Principal observations (polarization, spectral, brightness, microwave, and temperature studies etc.) and interpretations regarding the surface of Mars; the white areas at the poles, the bright areas; and the dark areas, are discussed. Also discussed are the TV experiment of the Mariner IV flight; the flux of ultraviolet radiation and charged particles at the surface with respect to living organisms; and other selected observations. L.S.

N66-31473*# Kitt Peak National Observatory, Tucson, Ariz.

CO_2 BANDS AND THE MARTIAN SURFACE PRESSURE

Donald M. Hunten *In* Calif. Inst. of Tech. Proc. of the Caltech-JPL Lunar and Planetary Conf. 15 Jun. 1966 p 240–244 refs (See N66-31446 18-30) CFSTI: HC $7.00/MF $1.75

Spectroscopic measurements of the vibration-rotation bands of CO_2 in the Martian atmosphere were made, using a 60-inch telescope in conjunction with its spectrograph, to

determine the surface atmospheric pressure and composition of the atmosphere on the planet. The results suggest an atmosphere in which CO_2 is the major constituent, if not the only important one. It appears likely that the surface partial pressure of CO_2 is in the range of 4 to 7 mb, with the total pressure of about 11 to 7 mb. It seems likely that the partial pressure of other gases is not over 3 or 4 mb. This picture of a nearly pure CO_2 atmosphere is greatly strengthened by the Mariner IV results which suggest a high molecular weight and a pressure of 4 to 7 mb. The old photometric and polarimetric result of 85 mb is discredited. The discrepancy may have been due to additional scattering by aerosols in the atmosphere, or to the inherent difficulty of subtracting all the effects of light from the surface. L.S.

N66-31474*# California Univ., Berkeley.
SPECTROSCOPIC OBSERVATIONS OF MARS, 1964–5
Hyron Spinrad *In* Calif. Inst. of Tech. Proc. of the Caltech-JPL Lunar and Planetary Conf. 15 Jun. 1966 p 245–246 (See N66-31446 18-30) CFSTI: HC $7.00/MF $1.75

Doppler-shifted Martian water vapor lines were obtained with high resolution spectrograms of Mars. The amount of water vapor on Mars seems quite small, averaging about 15μ precipitable when it is detected. The location of the Mars H_2O apparently varies with Martian season, the weak lines first appearing over the subliming North Polar Cap, and migrating south over the planet. The abundance of CO_2 in the Martian atmosphere was also redetermined, using the $5\nu_3$ CO_2 band at λ8700. The preliminary result is ω_{CO_2}=80 m-atm CO_2, which gives a CO_2 partial pressure near 6 mb. Combining this result with other recent data on the saturated CO_2 band at 1.6μ, the total Mars surface pressure $P_s=8^{+6}_{-4}$ mb. CO_2 is therefore the major constituent. A portion of the Mars spectrum at the $5\nu_3$ CO_2 band is depicted. Positions of the weak rotational lines of CO_2 in the R and P branches are indicated. The clearly visible R12, 10, and 8 lines are noted. L.S.

N66-31475*# IIT Research Inst., Chicago, Ill.
RECENT OBSERVATIONS OF THE PHOTOGRAPHIC SPECTRUM OF MARS—A PRELIMINARY REPORT
Tobias Owen *In* Calif. Inst. of Tech. Proc. of the Caltech-JPL Lunar and Planetary Conf. 15 Jun. 1966 p 247–251 refs (See N66-31446 18-30) CFSTI: HC $7.00/MF $1.75

The CO_2 abundance in the Martian atmosphere was redetermined spectroscopically by means of observations in the weak bands of 8689 Å and 1.05 μ. One plate of the 8689 Å band which recorded measurable absorptions for lines in the P and R branches is reproduced. The means of reducing the data, which included determining the mean atmospheric temperature, correction of line intensities, and determination of air mass are described; and the result obtained for the CO_2 abundance from the foregoing parameters is given. The derived value of CO_2 abundance was 67±20 m-atm. The corresponding surface pressure was calculated by two independent methods, (method of Moroz, and method of Owen and Kuiper) and lies between 8 and 9 mb with a lower limit of 5 mb and an upper limit of 20 mb. The low surface pressure and high CO_2 content suggests that the present atmosphere of Mars may be similar in composition to the primitive outgassed atmosphere of the earth, with the exception of the low Martian abundance of water. This implies that Mars may never have had a more massive atmosphere than it possesses at the present time. L.S.

N66-31476*# Smithsonian Astrophysical Observatory, Cambridge, Mass.
RADIO AND RADAR EVIDENCE ON THE STRUCTURE AND COMPOSITION OF THE MARTIAN SURFACE
Carl Sagan and James B. Pollack *In* Calif. Inst. of Tech. Proc. of the Caltech–JPL Lunar and Planetary Conf. 15 Jun. 1966 p 255–256 (See N66-31446 18-30) CFSTI: HC $7.00/MF $1.75

This paper briefly describes some evidence on the structure and composition of the Martian surface as deduced from radar and radio observations. The evidence discussed includes Martian surface reflectivities, dielectric constants, porosity, and temperatures. R.N.A.

N66-31477*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
PRELIMINARY RESULTS OF THE MARINER IV OCCULTATION MEASUREMENT OF THE ATMOSPHERE OF MARS
A. J. Kliore, D. L. Cain, G. S. Levy, V. R. Eshleman, G. Fjeldbo (Stanford Univ.) et al *In* Calif. Inst. of Tech. Proc. of the Caltech–JPL Lunar and Planetary Conf. 15 Jun. 1966 p 257–266 refs (See N66-31446 18-30) CFSTI: HC $7.00/MF $1.75
(Contract NAS7-100; Grants NGR-05-020-65; NsG-377)

This paper reviews the preliminary results of the radio occultation measurement of the Martian atmosphere conducted as the Mariner IV spacecraft passed behind the planet. Results of the data analysis showed that values of density, pressure, scale height, and temperature near the Martian surface were lower than expected. Based on the occultation results and terrestrial spectroscopic measurements of CO_2 abundance in the atmosphere of Mars, it is concluded that CO_2 must be the primary atmospheric constituent. R.N.A.

N66-31478*# Stanford Univ., Calif.
PRELIMINARY RESULTS OF THE MARINER IV RADIO OCCULTATION MEASUREMENTS OF THE UPPER ATMOSPHERE OF MARS
G. Fjeldbo, V. R. Eshleman, A. J. Kliore, D. L. Cain (JPL), F. D. Drake (Cornell Univ.) et al *In* Calif. Inst. of Tech. Proc. of the Caltech–JPL Lunar and Planetary Conf. 15 Jun. 1966 p 267–272 refs (See N66-31446 18-30) CFSTI: HC $7.00/MF $1.75
(Contract NAS7-100; Grants NGR-05-020-065; NsG-377)

This paper discusses that part of the radio occultation measurement of the Martian atmosphere, conducted as the Mariner IV spacecraft passed behind the planet, that is related to the upper atmosphere of Mars. An attempt is made to show how the Martian atmosphere changes with altitude, i.e., the temperature profile, number density profiles, etc., together with the controlling physical and chemical processes. A summary of the more striking features of the upper atmosphere of Mars is tabulated. R.N.A.

N66-31479*# California Inst. of Tech., Pasadena.
COMMENTS ON THE MARINER IV PHOTOGRAPHS OF MARS
Robert B. Leighton *In its* Proc. of the Caltech–JPL Lunar and Planetary Conf. 15 Jun. 1966 p 273–278 (See N66-31446 18-30) CFSTI: HC $7.00/MF $1.75

An interm account is presented of the processing and some of the preliminary measurements made of the Mariner IV photographs of Mars. Four of the computer processed photographs are shown and comments made on their details. The most obvious feature revealed is the presence of craters which are apparently distributed variably over the planet. There are many small craters of less than 10 km in diameter. The larger and medium sized craters have rather flat floors as compared with similar lunar craters. A plot comparing the Martian crater distribution with lunar uplands and maria shows that the Martian crater density is 3.5 times greater than that of the

lunar maria but does not approach the densely packed condition of the lunar uplands. An analysis of the crater wall slopes and heights is also shown. R.N.A.

N66-31481*# Paris Observatory, Meudon (France).
CONTRIBUTION TO THE CALTECH-JPL COLLOQUIUM ON THE MOON AND THE PLANETS: MARS [CONTRIBUTION AU COLLOQUE CALTECH-JPL SUR LA LUNE ET LES PLANETES: MARS]
Audouin Dollfus *In* Calif. Inst. of Tech. Proc. of the Caltech-JPL Lunar and Planetary Conf. 15 Jun. 1966 p 289-305 refs In FRENCH (See N66-31446 18-30) CFSTI: HC $7.00/MF $1.75

Attention is given to the measurement of water in the atmosphere of Mars and the photometric properties of the Martian soil in a review of contributions of the conference. It is noted that water vapor is not always detectable in the spectrum of Mars, but that it sometimes appears on certain locations of the planet. Absolute values obtained for the luminosity of the light and dark sides of Mars are discussed, and variations in diffusion are graphed as a function of phase angle and distance from the center of the core. Diffusion of the Martian atmosphere can be determined by measuring the polarization of light, and curves are plotted for the visual and photoelectric spectra from 0.50 to 1.05μ. Residual pollution in the Martian atmosphere and spectroscopic findings by Mariner IV are mentioned. It is noted that the dark spots of the Martian soil almost completely disappear in the blue spectrum, and transparency of the atmosphere in this region is discussed. Transl. by M.W.R.

N66-31486*# Virginia Polytechnic Inst., Blacksburg.
PROCEEDINGS OF THE CONFERENCE ON THE EXPLORATION OF MARS AND VENUS
Aug. 1965 320 p refs Conf. held at Va. Polytech. Inst., Blacksburg, 23-27 Aug. 1965 *Its* Eng. Extension Ser. Circ. No. 5
(Grant NGR-47-004-008)
(NASA-CR-76363) CFSTI: HC $7.00/MF $1.75 CSCL 03A

CONTENTS:

1. THE ORBITS AND THE GRAVITATIONAL FIELDS OF MARS AND VENUS D. Brouwer (Yale Univ. Obs.) 6 p refs (See N66-31487 18-30)

2. BALLOON-TELESCOPE OBSERVATION OF THE PLANETS J. D. Strong (Johns Hopkins Univ.) 8 p refs (See N66-31488 18-30)

3. SOME ASPECTS OF THE CIRCULATION OF MARS C. Leory (RAND Corp.) 10 p refs (See N66-31489 18-30)

4. THE INTERIORS OF MARS AND VENUS S. K. Runcorn (Newcastle Univ.) 6 p refs (See N66-31490 18-30)

5. THE SYSTEMATIC INVESTIGATION OF THE METEOROLOGY OF MARS M. Tepper (NASA) 14 p ref (See N66-31491 18-30)

6. THE POSSIBILITIES OF LIFE ON MARS F. B. Salisbury (Colo. State Univ.) 16 p refs (See N66-31492 18-30)

7. CHEMICAL STUDIES ON THE ORIGIN OF LIFE C. Ponnamperuma (NASA. Ames Res. Center) 8 p refs (See N66-31493 18-04)

8. SPECIAL ORBITS FOR THE EXPLORATION OF MARS AND VENUS V. G. Szebehely (Yale Univ. Obs.) 12 p refs (See N66-31494 18-30)

9. SCIENTIFIC RESULTS OF MARINER MISSIONS TO MARS AND VENUS R. K. Sloan (JPL) 38 p refs (See N66-31495 18-30)

10. GOALS OF THE VOYAGER PROGRAM R. Fellows (NASA) 12 p (See N66-31496 18-31)

11. A FUTURE AUTOMATED BIOLOGICAL LABORATORY V. I. Oyama (NASA. Ames Res. Center) 14 p refs (See N66-31497 18-04)

12. REVIEW OF MARINER 1962 AND 1964 SPACECRAFT DESIGN AND OPERATIONAL PLANNING D. Schneiderman (JPL) 16 p (See N66-31498 18-31)

13. SCIENCE PAYLOADS FROM MARINER II TO MARINER IV R. V. Meghreblian, F. L. Schutz, and W. G. Fawcett (JPL) 14 p refs (See N66-31499 18-31)

14. THE PROBLEMS OF PREPARING FOR NEW SPACECRAFT PROGRAMS P. N. Haurlan (JPL) 16 p refs (See N66-31500 18-30)

15. ORBITER MISSION DESIGN PROBLEMS P. K. Eckman (JPL) 24 p refs (See N66-31501 18-30)

16. PROBE AND LANDER DESIGN PROBLEMS L. Roberts (NASA. Langley Res. Center) 10 p refs (See N66-31502 18-31)

17. SPACE—QUESTIONS AND ANSWERS E. M. Cortright (NASA) 6 p (See N66-31503 18-30)

18. MANNED PLANETARY RECONNAISSANCE MISSION STUDY: VENUS/MARS FLYBY H. O. Ruppe (NASA. Marshall Space Flight Center) 44 p refs (See N66-31504 18-31)

19. PROBLEMS AND POSSIBILITIES OF EXPLORATION OF MARS SURFACE BY MANNED LANDINGS R. Festa (NASA. Marshall Space Flight Center) 9 p (See N66-31505 18-30)

N66-31487*# Yale Univ. Observatory, New Haven, Conn.
THE ORBITS AND THE GRAVITATIONAL FIELDS OF MARS AND VENUS
Dirk Brouwer *In* VPI Proc. of the Conf. on the Exploration of Mars and Venus Aug. 1965 6 p refs (See N66-31486 18-30) CFSTI: HC $7.00/MF $1.75

Data are presented on the orbits and gravitational fields of Mars and Venus as well as the orbits of Martian satellites. A historical background is included and data are given on planetary theories and typical planetary periodic perturbations. It is noted that the principal perturbations in the motions of the satellites Phobos and Deimos arise from the oblateness of Mars. While the orientation of the axis of Mars is well known, both from its surface markings and from observations of its satellites; Venus lacks distinct surface markings. Optical observations have, therefore, not yielded any definitive information on the period or orientation of the axis of rotation. Recent radar Doppler observations indicate a rotation period of 250±50 in retrograde direction. The mass of Venus is discussed. M.W.R.

N66-31488*# Johns Hopkins Univ., Baltimore, Md.
BALLOON-TELESCOPE OBSERVATION OF THE PLANETS
John D. Strong *In* VPI Proc. of the Conf. on the Exploration of Mars and Venus Aug. 1965 8 p refs (See N66-31486 18-30) CFSTI: HC $7.00/MF $1.75

The determination of water vapor in the upper atmosphere of Venus by an automatic telescope-spectrometer unit aboard a balloon at an altitude of 27 km is discussed. Various aspects of the data recording system, data reduction, and results are presented. The 21 positions of the exit slits used are given, a single slit scan across the water band is graphed, and a double scan showing absorption by water vapor is pictured. The reflection spectrum of Venus clouds is graphed to show correction for the upper atmosphere of Venus, and the terrestrial water above 26.5 km is illustrated. It is concluded that, within limits set by the uncertainties of the agreement, the effective cloud reflections determined for radiations of

1.1, 1.9, and 2.6 microns all lie at essentially the same altitude. It is noted that the Venus cloud surface temperature is about −40° C, and does not vary significantly from light to dark side. The latent heats and freezing of water provide the mechanism for sustaining this temperature on the dark side. M.W.R.

N66-31489*# RAND Corp., Santa Monica, Calif.
SOME ASPECTS OF THE CIRCULATION OF MARS
Conway Leory *In* VPI Proc. of the Conf. on the Exploration of Mars and Venus Aug. 1965 10 p refs (See N66-31486 18-30) CFSTI: HC $7.00/MF $1.75

Vertical temperature distribution, diurnal heating and tides, and differential heating and general circulation at the solstices are discussed in connection with the circulation of the Martian atmosphere. A schematic diagram of solstice circulation on Mars indicates that the winter hemisphere contains strong zonal west winds that increase with height, except for a shallow belt of easterlies near the ground in low latitudes. The summer hemisphere is dominated by easterlies increasing with height, except for a relatively shallow belt of surface westerlies. The meridonal circulation associated with the eddy regime has descending motion toward the equator of the west wind maximum and ascending motion poleward of the maximum; and such circulation results from the zonal momentum produced by the eddies. Various circulation estimates are given and observations are graphed. M.W.R.

N66-31490*# New Castle Univ. (England).
THE INTERIORS OF MARS AND VENUS
S. K. Runcorn *In* VPI Proc. of the Conf. on the Exploration of Mars and Venus Aug. 1965 6 p refs (See N66-31486 18-30) CFSTI: HC $7.00/MF $1.75

Characteristics of Mars and Venus are discussed in terms of determining the interiors of these planets. Evidence is presented which indicates that the core of Mars is small, nonexistent, or solid; as well as to the absence of significant electromagnetic coupling between the mantle and core. Data from seismological investigations are used to exclude the possibility of a core for Mars, since the central pressure is not high enough to cause a phase change. While this information has been used in the construction of models, there are certain shortcomings in these and other related hypotheses, particularly when attempts are made to determine the temperature distribution within the terrestrial planets. It is pointed out that the fact that the Martian surface shows no evidence of folded mountains or volcanism does not mean that internal motions or convection are not occurring. M.W.R.

N66-31491*# National Aeronautics and Space Administration, Washington, D. C.
THE SYSTEMATIC INVESTIGATION OF THE METEOROLOGY OF MARS
Morris Tepper *In* VPI Proc. of the Conf. on the Exploration of Mars and Venus Aug. 1965 14 p ref (See N66-31486 18-30) CFSTI: HC $7.00/MF $1.75

Weather observation and prediction for the manned Mars landing program is discussed. Four approaches used in forecasting are briefly summarized: analogue, statistical, empirical, and numerical. The dynamical or numerical approach is chosen as the most applicable to Mars. The acquisition of atmospheric data globally on Mars is described as analogous to observations on Earth. A solution to the problem of obtaining data lies in the use of Earth orbiting satellites. The satellite is discussed as an instrument platform and as a data collection and relay device. S.P.

N66-31492*# Colorado State Univ., Fort Collins.
THE POSSIBILITIES OF LIFE ON MARS
Frank B. Salisbury *In* VPI Proc. of the Conf. on the Exploration of Mars and Venus Aug. 1965 16 p refs (See N66-31486 18-30) CFSTI: HC $7.00/MF $1.75

Arguments are presented supporting two contradictory hypotheses that Mars is a completely dead world and that it supports a complete biota, including an intelligence capable of highly advanced technology. Life as it is known on earth is discussed with respect to existence of primitive plants, and it is suggested that a more flourishing well adapted life form is present on Mars. The density of markings and the fact that primitive plants envisioned on Mars do not show color changes typical of the markings are stated as proof of a more advanced type of plant growth. Species of mealworm, germinating seeds, fungi, a dwarf palm, and common soil bacteria grown under simulated Martian conditions are discussed. Various theories and UFO sightings are briefly described to support the conclusion that some form of advanced life does exist on Mars. S.P.

N66-31494*# Yale Univ. Observatory, New Haven, Conn.
SPECIAL ORBITS FOR THE EXPLORATION OF MARS AND VENUS
Victor G. Szebehely *In* VPI Proc. of the Conf. on the Exploration of Mars and Venus Aug. 1965 12 p refs (See N66-31486 18-30) CFSTI: HC $7.00/MF $1.75

Optimization problems involving swing-by trajectories and capture orbits are presented and the numerical methods for treating these problems with high accuracy are described. Examples stressing the analytical, dynamical, and numerical aspects of several fundamental problems of research in the field of interplanetary trajectories are formulated. Preliminary analysis shows that swing-by operations almost always save fuel but take more time than standard operations, and that with planet-to-planet swing-by maneuvers one may be able to pass near to all the major planets on a single trip. Because both swing-by trajectories and capture orbits require high accuracy for operational and theoretical reasons the motion equations must be regularized to prevent error accumulations at close approaches. This computational method consisting of the introduction of variables such that the singularities of the differential equations of motion are eliminated is discussed. A.G.O.

N66-31495*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SCIENTIFIC RESULTS OF MARINER MISSIONS TO MARS AND VENUS
Richard K. Sloan *In* VPI Proc. of the Conf. on the Exploration of Mars and Venus Aug. 1965 38 p refs (See N66-31486 18-30) CFSTI: HC $7.00/MF $1.75

The methods used to measure the exospheric structure in order to determine whether Mars and Venus have Van Allen type radiation belts, and hence a magnetic field, are described. The Mariner II and Mariner IV spacecrafts, and their complements of experiments, are discussed in relation to systems design and mission trajectories and profiles. Comparative data obtained from each mission are given for the five major disciplines in planetary sciences: planetary atmosphere, planetary interiors, planetary surfaces, planetary exospheres, and dynamical constants. Photographs taken by Mariner IV are included, along with brief interpretations of each frame. M.G.J.

N66-31500*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

THE PROBLEMS OF PREPARING FOR NEW SPACECRAFT PROGRAMS

Peter N. Haurlan *In* VPI Proc. of the Conf. on the Exploration of Mars and Venus Aug. 1965 16 p refs (See N66-31486 18-30) CFSTI: HC $7.00/MF $1.75

This paper describes the process of selecting new unmanned spacecraft programs, indicates the criteria used, defines the efforts required, lists the types of problems involved, and, in particular, defines the roles of the space scientist and the industrial manager. Although emphasis is on the problems of preparing for new unmanned spacecraft projects, the presentation is generated within the framework of a typical functional flow diagram of the project selection process. Each functional element is discussed along with an outline of its problem area. After discussing a typical project selection process, it is applied to the major problem of determining what is to follow after the Voyager Mars project. R.N.A.

N66-31501*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

ORBITER MISSION DESIGN PROBLEMS

Philip K. Eckman *In* VPI Proc. of the Conf. on the Exploration of Mars and Venus Aug. 1965 24 p refs (See N66-31486 18-30) CFSTI: HC $7.00/MF $1.75

Detailed consideration is given to the problem of planetary orbit design and selection for a hypothetical orbiting mission. In considering the design of planetary orbiting missions, particular emphasis must be given to selecting the orbit itself. Many factors must be carefully considered to arrive at an acceptable orbit profile. If the orbiter is to be unsterilized, one of the most important factors is the selection of a periapsis altitude which is sufficiently high to assure an acceptable minimum orbit lifetime. It is necessary to define a standard high altitude density model and an orbiter sterilization policy which are consistent with the mission objectives. Potentially attractive orbit profiles can be found which satisfy most of the desired mission constraints. Increasing periapsis altitude provides long orbit lifetime, improves the Canopus geometry, and delays or avoids sun occultation. However, the resolution of Mars oriented experiments will decrease and the chances of performing an earth occultation experiment diminishes. Southerly direct orbit profiles appear attractive and result in good coverage of the preferred southerly Mars latitudes. Author

N66-31503*# National Aeronautics and Space Administration, Washington, D. C.

SPACE—QUESTIONS AND ANSWERS

Edgar M. Cortright *In* VPI Proc. of the Conf. on the Exploration of Mars and Venus Aug. 1965 6 p (See N66-31486 18-30) CFSTI: HC $7.00/MF $1.75

This paper attempts to answer several questions concerning the space program. The questions include: Why explore space? Is there really a space race? Who has made the greatest strides in space? Can we afford a civilian space program? Why have both a civilian and military space program? Will the unmanned program be swallowed up by the manned program? What is the single most difficult problem in carrying out the space program? Are incentive contracts just another gimmick? What is the role of nuclear energy in the space program? Why confine ourselves to Mars and Venus when the whole solar system is accessible? When will we have manned planetary exploration? Have we compromised our scientific integrity in selling our programs to Congress? Do many scientists really oppose the space program? R.N.A.

N66-31505*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

PROBLEMS AND POSSIBILITIES OF EXPLORATION OF MARS SURFACE BY MANNED LANDINGS

Rudolf Festa *In* VPI Proc. of the Conf. on the Exploration of Mars and Venus Aug. 1965 9 p (See N66-31486 18-30) CFSTI: HC $7.00/MF $1.75

This paper discusses the special problem areas and possibilities of a manned Mars landing. Most of the problems discussed center around the human factor and include the use of man versus machine, man-machine relations, dangers of space travel and a Mars landing to man, justifications for exploring Mars, life detection, contamination, international cooperation, and surveillance of foreign space programs. R.N.A.

N66-31540# Aeronautical Chart and Information Center, St. Louis, Mo. Linguistic Section.

DETERMINATION OF THE TRAJECTORY OF A BODY, USING THE SECOND DERIVATIONS OF POTENTIALS [OPREDELENIYE TRAYEKTORII TELA PO VTORYM PROIZVODNYM POTENTSIALA]

V. P. Chulkov-Eyman Apr. 1966 7 p Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Geod. i Aerofotos. (Moscow), no. 5., 1963 p 95–97

(TC-1011; TT-66-61372; AD-633406) CFSTI: HC $1.00/MF $0.50

The press reports of recent years mention the attempts to use the earth's gravity field for the orientation of space ships. According to the published data, the attainable orientation accuracy is of an order of 1–2 min. As data units of different kinds, the control systems use the inertia systems which measure certain linear functions of second derivations of the potential. The accuracy of measurements amounts to 10 to −4 of the measured value. In the present article it is shown that the measurement of the second derivations of potential can be used not only for the purposes of orientation, but also for the determination of a trajectory of the body. The demonstration is carried out with the aid of two idealized models.

Author (TAB)

N66-31620# Bologna Univ. (Italy). Inst. of Physics.

RESULTS OF AN X-RAY SCANNING OF THE SKY IN THE 20–200 KeV ENERGY RANGE

D. Brini, D. Cattani, U. Ciriegi, F. Fuligni, M. Galli et al Jul. 1965 8 p refs Submitted for Publication *Its* Vol. 28, No. 6 CFSTI: HC $1.00/MF $0.50

An X-ray scanning of the sky for the energy region above 20 KeV was performed by a directional detector for X-rays consisting of a NaI (Tl) scintillator during a flight carried out at Aire/s/l'Adour (France) on 13 Apr. 1965 at a geomagnetic latitude of 45 deg. By grouping the detector countings in azimuthal intervals of 30 deg an increase in the counting rate in the 210–270 deg azimuthal interval was observed. The data obtained are in general agreement with the results of the NRL and of the Rochester groups. The values of the fluxes obtained corresponding to this range are shown in fig. 3 G.S.

N66-31641*# Smithsonian Astrophysical Observatory, Cambridge, Mass.

PROPERTIES OF THE CLOUDS OF VENUS

Carl Sagan and James B. Pollack *In its* Selected Studies in Exobiol., Planetary Environments, and Probl. Related to the Origin of Life, Jun. 1966 16 p refs (See N66-31639 18-04) CFSTI: HC $4.00/MF $1.00

We have obtained in the Schuster-Schwarzschild approximation theoretical formulae describing the monochromatic

transmissivity, reflectivity, and absorptivity of a cloud layer characterized by an arbitrary single scattering albedo and anisotropic phase function. The application of this formalism combined with exact solutions to the Mie theory problem to the observed visual and near infrared reflectivity of Venus permits the determination of a number of properties of the Cytherean cloud layer. We confirm Strong's identification of ice as the principal constituent of the clouds. In addition the mean radius of cloud particles lies between 7.5μ and 10μ, while the interaction optical depth of the layer is between 18 and 43. Clouds with these properties allow a sizeable fraction of the incident sunlight to penetrate to the surface, but are extremely opaque to radiation thermally produced by the planet. A greenhouse mechanism therefore appears to be operative which can explain the high surface temperature of Venus. Author

N66-31642*# Smithsonian Astrophysical Observatory, Cambridge, Mass.

THERMODYNAMIC EQUILIBRIA IN PLANETARY ATMOSPHERES

Ellis R. Lippincott (Maryland Univ.), Richard V. Eck (Natl. Biomed. Res. Found.), Margaret O. Dayhoff, and Carl Sagan *In its* Selected Studies in Exobiol., Planetary Environments, and Probl. Related to the Origin of Life Jun. 1966 37 p refs (See N66-31639 18-04) CFSTI: HC $4.00/MF $1.00

The thermodynamic equilibrium composition of all possible combinations of the elements C, H, O, and N at reasonable average pressures and temperatures have been calculated for the atmospheres of Earth, Venus, Mars, and Jupiter. All regions of the composition diagram consistent with the observed molecular abundances are located and discussed. The atmosphere of Venus seems likely to be in thermodynamic equilibrium. It then follows that the measured upper limits on the abundances of CH_4, NH_3, and CO are all inconsistent with the possibility of elemental carbon or hydrocarbons in contact with the atmosphere, either on the surface or as clouds. Venus must have begun its evolutionary history with a [C/O] abundance ratio$\leq$0.5, a value consistent with several cosmic abundance estimates. The evidence for Mars is not inconsistent with thermodynamic equilibrium. Equilibrium abundances of all oxides of nitrogen are extremely low even if computed with a considerable excess of O_2. Under equilibrium conditions at low temperatures Jupiter also cannot contain significant amounts of any molecule not yet observed. However, at high temperatures simple hydrocarbons and cyanides, polycyclic aromatics, and a variety of nitrogen compounds would be expected. Some of these compounds are brightly colored and possibly contribute to the observed variable coloration of Jupiter. Author

N66-31647# Air Force Academy, Colo. Frank J. Seiler Research Lab.

A COMPUTATIONAL PROCEDURE FOR OPTIMUM TRAJECTORY AND OPTIMAL CONTROL PROBLEMS

Rinaldo F. Vachino *In* Office of Aerospace Res. Proc. of the OAR Res. Appl. Conf. [1966] p 1-9 refs (See N66-31646 18-34) CFSTI: HC $5.00/MF $1.00

An extension of the method of steepest descent which makes this technique applicable to a more general class of problems is discussed relative to optimum trajectory and control problems. This class of problems is characterized by the presence of inequality constraints on the control variables; these arise from the physical limitations that are present in a realistic environment. An example is used to illustrate the application of this method, and shows that the method gives rise to a sequence of approximations that converge to the optimum solution, even when the initial control function differs drastically from the optimum control. The method offers an automatic computer technique that calculates the solutions to problems of a variety of physical situations. C.T.C.

N66-31668*# TRW Systems, Redondo Beach, Calif.

CONCEPTUAL DESIGN STUDY FOR A MARS ENTRY VEHICLE DAMPER

R. A. Winje Washington, NASA, Jul. 1966 79 p refs (Contract NAS5-9198)

(NASA-CR-525) CFSTI: HC $3.00/MF $0.75 CSCL 22A

The results of an analytic study to define a passive damping system to reduce angle-of-attack oscillations of a nonspinning needle-nosed probe entering the Martian atmosphere are presented. The design criteria were generated and then a conceptual design for a passive damping system was developed to satisfy those criteria. In concept, the damping system consists of a mass–spring–dashpot configuration which is tuned to the frequency of angle-of-attack oscillation during the early portion of the entry trajectory. Relative motion between the damper mass and the entry vehicle results in energy dissipation through the dashpot mechanism and inelastic impact at the boundaries of the damper mass excursion. The effectiveness of the system is determined by comparing the damped angle-of-attack envelope to the undamped envelope. Reductions in envelope amplitude of an order of magnitude can be realized with the damper system. Author

N66-31702*# Lockheed Missiles and Space Co., Huntsville, Ala. Huntsville Research and Engineering Center.

RESEARCH IN STABILITY OF PERIODIC MOTIONS Quarterly Progress Report, 3 Feb.–4 May 1966

D. L. Hitzl and John White [1966] 25 p refs (Contract NAS8-20323)

(NASA-CR-76423; LMSC/HREC-A782770) CFSTI: HC $1.00/MF $0.50 CSCL 22A

The use of Hamiltonian equations of motion, the Cauchy existence theorem, and Sundman lemmas in problems in celestial mechanics is discussed. The purpose of the calculations are to develop procedures for evaluating the stability of approximately periodic motion for a specified, finite time. Primary emphasis was placed upon the area-preserving mapping near a fixed point developed by Birkhoff and extended by Moser and Arnold. In this context, the fixed point is the true periodic orbit which closes exactly upon itself after a time t=T=period. A small neighborhood of the fixed point at t=0 is mapped into corresponding neighborhood at t=T; and in this way rigorous analytical results concerning the stability of the approximate periodic motions can be obtained. L.S.

N66-31780# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.

A PRELIMINARY ANALYSIS OF THE MECHANICAL PROPERTIES OF POSTULATED LUNAR VESICULAR ROCKS

L. L. Karafiath Jun. 1966 32 p refs (RM-328)

A preliminary theoretical evaluation of the mechanical properties of vesicular materials in relationship with their porosity is presented, and the mechanical properties of postulated lunar vesicular rocks with respect to the planned engineering operations on the moon are assessed. Author

N66-31811*# National Aeronautics and Space Administration, Washington, D. C.

AAP CONCEPT (ENGINEERING)

William B. Taylor *In its* Proc. of the Experimenters' Inform. Meeting on the Apollo Appl. Program in Biosci. 1966 p 51–66 (See N66-31806 18-04) CFSTI: HC $3.00/MF $1.00

Major study areas and engineering problems for the proposed Apollo Application Program are summarized for: Space operations and technology; meteorology; communication; earth resources; astronomy; physical sciences; bioscience; and lunar exploration. Basic Apollo missions have to be extended by added capabilities to conduct the required operations and to develop the corresponding technology for the proposed experiments. Apollo application planning schedules, configurations for early flights, lunar orbiting LEM configurations, and orbiting laboratory facilities are outlined and their implementations for bioscience studies discussed. G.G.

N66-31812*# National Aeronautics and Space Administration, Washington, D. C.

PLANNING OF SCIENTIFIC AND TECHNICAL EXPERIMENT PAYLOADS FOR AAP

Theodore A. George *In its* Proc. of the Experimenters' Inform. Meeting on the Apollo Appl. Program in Biosci. 1966 p 67–74 (See N66-31806 18-04) CFSTI: HC $3.00/MF $1.00

A statistical breakdown of past and future experiments in earth orbital missions is presented that lists all completed experiments during Mercury and Gemini flights and outlines the scheduled experiments for future Gemini and Apollo missions. Experiments are planned in the areas of astronomy, bioscience, physical science, atmospheric science, earth science and resources, communications and navigation, and biomedicine. G.G.

N66-31823*# AVCO Corp., Lowell, Mass. Space Systems Div.

COMPARATIVE STUDIES OF CONCEPTUAL DESIGN AND QUALIFICATION PROCEDURES FOR A MARS PROBE/LANDER. VOLUME V: SUBSYSTEM AND TECHNICAL ANALYSIS. BOOK I: TRAJECTORY ANALYSIS Final Report

D. P. Fields et al 11 May 1966 452 p refs

(Contract NAS1-5224)

(NASA-CR-66135; AVSSD-0006-66-RR Vol. V, Bk-1) CFSTI: HC $5.02/MF $2.25 CSCL 22C

Two mission modes for the Mars probe atmospheric entry are discussed; entry from the approach trajectory, and entry from orbit, including requirements for choice of launch period. To insure a soft landing from the approach hyperbola atmospheric retardation must be employed in conjunction with a terminal retardation technique. Because of the constraint that the payload must be deposited on the surface and relay communications terminated several hours prior to orbit injection maneuver, the attainment of shallow entry angles poses extremely stringent accuracy requirements on the attitude control system during the separation maneuver. An analysis was initiated to determine the payload capability for entry from orbit. For nine nominal orbits, the flight capsule de-orbit parameters were developed so that the entry angle and the communication geometry constraints were simultaneously satisfied. Four basic de-orbit methods were investigated, but it was found that all optimum conditions cannot be simultaneously achieved. The choice of launch parameters is dependent on mission mode requirements, but the present constraints can be satisfied during the 1971–1975 launch times. E.A.O.

N66-31834# Royal Observatory, Edinburgh (Scotland).

THE EFFECT OF ROTATION ON STELLAR LUMINOSITY

J. G. Ireland [1965] 32 p refs *Its* Publ. of the Roy. Obs., Vol. 5, No. 5

CFSTI: HC $2.00/MF $0.50

The effect of rapid rotation on the distribution of temperature and luminosity over the surface of a star is considered for the case of two simple models: the Roche model (where the major part of the stellar mass is located in the star's core), and the model of uniform density. It is suggested that an error in spectral classification of anything up to about five sub-classes could result in observations on B-stars in rapid rotation, the magnitude of this error depending on the angle at which the star is viewed. The possible influence of rotation on the position of a star in the Hertzsprung–Russell diagram is briefly discussed. Author

N66-31852*# Aeronutronic, Newport Beach, Calif.

FEASIBILITY STUDY FOR LUNAR WORM PLANETARY ROVING VEHICLE CONCEPT Final Technical Report

F. A. Dobson and D. G. Fulton 27 Jul. 1966 202 p refs

(Contract NAS1-5709)

(NASA-CR-66098; RSC-6720) CFSTI: HC $3.75/MF $1.25 CSCL 22A

Analytic studies are described concerning the feasibility of the bellows vehicle concept for use on the moon. Mobility analyses are presented for extension–contraction type bellows vehicles, rib-walking types, and traveling wave modes. Effort was directed primarily toward treatment of bellows mobility and structure, including both corrugated and membrane bellows, and applying the results to several brief design studies of typical missions. Design studies are described for movable lunar shelters, a small unmanned vehicle having limited range, and a manned roving vehicle having extended range. Overall evaluations are made from considerations of mobility, structural limitations, and propulsive energy. A lunar surface model suitable for short stroke and cyclic motion studies is developed. The traveling wave bellows concept appears to be potentially the most versatile since it provides the capability of moderate to high speeds over rough terrain with a smooth ride and good maneuverability. S.P.

N66-31886*# General Dynamics/Fort Worth, Tex.

A STUDY OF JUPITER FLYBY MISSIONS Final Technical Report

L. E. Hove et al 17 May 1966 678 p refs Prepared for JPL

(Contracts NAS7-100; JPL-951286)

(NASA-CR-76461; FZM-4625) CFSTI: HC $7.28/MF $3.25 CSCL 22A

A feasibility study was conducted to develop spacecraft design concepts for a Jupiter flyby mission. The tasks, constraints, and technical approach are delineated, their relationship to the overall study is indicated, and the design philosophy is discussed. The results indicate that a flyby mission to Jupiter is feasible during the 1973–1980 time period. In determining this feasibility, the general characteristics of Jupiter missions were surveyed in terms of scientific objectives and trajectory considerations. Spacecraft subsystem designs applicable to a Jupiter flyby spacecraft and compatible with the various scientific and mission performance requirements were evolved. The subsystems were integrated into four spacecraft design concepts which represent a range of alternate concepts. The four spacecraft were individually evaluated in terms of launch vehicle requirements, probability of mission success, development requirements, and program costs. A design summary of each spacecraft design concept is included. R.N.A.

N66-31889*# Consultants and Designers, Inc., Arlington, Va.
HIGHLIGHTS OF THE PRESS CONFERENCE AT THE MOSCOW HOUSE OF SCIENTISTS ON 10 FEBRUARY 1966 [PRESS-KONFERENTSIYA V MOSKOVSKOM DOME UCHENYKH]
17 Feb. 1966 13 p Transl. into ENGLISH from Pravda (Moscow), no. 42, 11 Feb. 1966
(Contract NAS5-9299)
(NASA-CR-76469; ST-PR-LPS-10448) CFSTI: HC $1.00/MF $0.50 CSCL 22A

The highlights of a Soviet press conference concerning the soft landing of Luna-9 on the moon are presented. After a few general remarks, detailed statements are made about the Luna-9's television camera, the photographs obtained, the probe's lunar surroundings, and the formation and composition of the lunar surface as interpreted from the photographs. This is followed by a general question and answer period. R.N.A.

N66-31900*# National Aeronautics and Space Administration, Washington, D. C.
MANNED SPACE FLIGHT 1966
1966 34 p
(NASA-TM-X-57746) CFSTI: HC $2.00/MF $0.50 CSCL 22A

This report examines the U.S. manned space flight program in terms of its competition with the U.S.S.R., its status today, the investment, resources, investment returns to date, optional manned space flight missions, and needed program decisions. R.N.A.

N66-31926*# Minnesota Univ., Minneapolis. School of Physics.
A STUDY OF THE FEASIBILITY OF EMPLOYING A MAGNETIC MASS SPECTROMETER FOR THE ANALYSIS OF THE MARTIAN ATMOSPHERE
Alfred O. C. Nier 20 Dec. 1962 58 p refs Prepared for JPL
(Contracts NAS7-100; JPL-950241)
(NASA-CR-76498) CFSTI: HC $2.50/MF $0.50 CSCL 03A

A study of magnetic-sector mass spectrometers has been conducted to test the feasibility of employing such instruments for making analyses of planetary atmospheres. A number of designs of spectrometers were tried, as were appropriate transistorized electronic circuits. A preliminary study of a miniature sputter ion pump was also carried out. The investigations showed that essentially all but the weight specification given in SW-2751 could be met. It is likely that further studies will result in weight reductions. This would certainly be the case if a reconsideration of the entire problem showed that some of the other specifications could be modified. Author

N66-31937*# Douglas Aircraft Co., Inc., Santa Monica, Calif. Atmospheric Sciences Branch.
AIRBORNE OBSERVATIONS OF THE COMET IKEYA-SEKI (1965f)
E. V. Petersen May 1966 45 p refs
(Contract NASw-1352)
(NASA-CR-76526; SM-52056) CFSTI: HC $2.00/MF $0.50 CSCL 03A

Observations of the comet Ikeya-Seki, based on selected aerial photographs and observations of the flight personnel, are presented. The airborne stabilized telescope system is described, including the heliostat system, Questar telescope, and instrumentation mounting. The flight observation procedure is reviewed, and navigation maps of the flight paths are supplied. Data analysis produced the following conclusions about the comet: (1) the tail of the comet increased in length from approximately 5 arc-min before perihelion to between 8 and 11 arc-deg after perihelion; (2) photographs after perihelion showed ban structure in the tail; (3) no separation of the comet's nucleus was evident; and (4) the comet was observed to have a strong sodium D emission line. Conclusions concerning airborne astronomical observations were also reached: (1) no obvious image smear of either the moon or Venus occurred with exposures of about 0.5 sec; and (2) observations of Venus with the current telescope system do not seem feasible when the separation angle is less than 10°. L.E.W.

N66-31944*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
THE ATMOSPHERE OF MARS: A DERIVATION OF ENGINEERING AND DESIGN PARAMETERS
W. T. Roberts and George S. West 29 Jun. 1966 38 p refs
(NASA-TM-X-53484) CFSTI: HC $2.00/MF $0.50 CSCL 03B

Three model atmospheres have been derived for use in mission planning, aerospace lander design, and Martian orbiter and flyby studies. Atmospheric parameters for these three models have been calculated from the planetary surface to 10,000 kilometers. These three model atmospheres of differing atmospheric composition, surface pressure, and surface temperature are the upper density model (60 percent CO_2 and 40 percent N_2); the mean density model (100 percent CO_2); and the lower density model (80 percent CO_2 and 20 percent Ar). The general program of Kern and Schilling, with a few revisions, was used; this publication contains the details of the mathematical basis and program routines in considerable depth. The models chosen should provide values which will be of use as guidelines for the engineering and design of orbiting and landing vehicles. Author

N66-31947# Royal Greenwich Observatory, Herstmonceux (England).
STUDIES OF THE GLOBULAR CLUSTER ω CENTAURI. I: CATALOGUE OF MAGNITUDES AND PROPER MOTIONS
London, HMSO, 1966 136 p refs *Its* Ann. No. 2
CFSTI: HC $3.00/MF $1.00

This paper gives a catalog of the positions and magnitudes in B and V of 6666 stars in the field of ω Centauri and of the proper motion displacements of 4525 of these stars, and a description of how they were obtained. A photoelectric sequence by Eggen is used to calibrate the photographic photometry which is based on a series of plates taken with the Victoria twin refractor at the Cape and with the Radcliffe 74-inch reflector at Pretoria. The data are set out in three tables: (1) stars with $V < 13^m.0$ in order of V magnitude, (2) all stars (excluding variables) in order of co-ordinate, and (3) the variable stars, for which light-curve parameters and mean magnitudes $<B>$ and $<V>$ are given. Author

N66-31973# Technische Univ., Berlin (West Germany). Institut fuer Raumfahrttechnik.
PROJECT STUDY OF A COMET PROBE [PROJEKTSTUDIE EINER KOMETENSONDE]
H. Scheel 22 Apr. 1966 27 p refs In GERMAN Presented at 7th DGRR Symp.
(TUB-IR-1966/1) CFSTI: HC $2.00/MF $0.50

Design and development of a cylindrical stabilizer sensor able to detect and approach comets up to a distance of $< 10^4$ km, is discussed. The proposed sensing device will encorporate a television system with optical rangefinder that will transmit comet pictures to an earth station for digital trajectory correction. Agitation of a small gas vent in the sensor's body will impart a torque impulse to the device and correct its orienta-

tion into the desired direction. A meteorite penetration probability analysis for such a device confirmed the possibility of meteorite hit able to penetrate the 1 mm thick aluminum skin of the sensor. G.G.

N66-31995# Astronomical Institutes of the Netherlands, Leiden.

FIVE-COLOUR PHOTOMETRY OF HIGH-VELOCITY STARS AND OF PULSATING VARIABLES OF DIFFERENT TYPES

J. Ponsen and P. Th. Oosterhoff Jan. 1966 36 p refs *Its* Bull. of the Astron. Inst. of the Neth., Suppl. Ser., Vol. 1, No. 1 CFSTI: HC $2.00/MF $0.50

Photoelectric measures in five-colour photometry are presented for high-velocity stars and pulsating variables of different types including some variables in the globular clusters ωCentauri and M 4. The observations were obtained by photometric measures with a light-collector. The measures were reduced to the same standard stars. Author

N66-31999# Smithsonian Astrophysical Observatory, Cambridge, Mass.

SOME NEW ALGORITHMS FOR STELLAR STRUCTURE

Peter D. Usher 27 May 1966 168 p refs *Its* Spec. Rept.-213

A study was conducted of numerical methods for the class of mathematical problem that includes the equations of quasi-static equilibrium of completely spherical stars. It is stated that the problem is best described as that of a fourth order, nonlinear, two-point boundary value problem. The study investigated a general perturbation expansion and its possible application to real stars. In addition, the role of the Riccati transformation in linear and linearized two-point boundary value problems, and the polytrope of index 1 in the light of some Sturmian theorems were examined. H.S.W.

N66-32006*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.

PUBLICATIONS OF GODDARD SPACE FLIGHT CENTER, 1963. VOLUME I: SPACE SCIENCES

[1963] 1556 p refs

(NASA-TM-X-57737) GPO: HC $9.75; CFSTI: MF $7.50 CSCL 03B

A collection of articles, papers, talks, and reports on astronomy and astrophysics, celestial mechanics and geodesy, solar physics, ionosphere and radio physics, fields and particles, planetology, planetary atmospheres and general topics are presented. For individual titles see N66-32007–N66-32043.

N66-32007*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.

INTERPLANETARY DUST

W. M. Alexander *In its* Publ. of Goddard Space Flight Center, 1963, Vol. I [1963] p 3–7 refs (See N66-32006 18-30) GPO: HC $9.75; CFSTI: MF $7.50

Measurements obtained from ground based and space experiments concerning dust particles with masses less than 10^{-6} gm are discussed. Direct measurements of dust particle flux by sounding rockets showed that the average flux in cis-lunar space was approximately 10^{-4} times that near earth. One set of ground based measurements from observations of the zodiacal light and the solar corona was compared to direct measurements from dust particle experiments on satellites. This comparison indicated that the spatial density of dust particles near the earth was approximately 10^{3} times greater than in interplanetary space. Additional experiments are discussed and the results of these experiments are analyzed. H.S.W.

N66-32009*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.

DISCOVERY OF A COMET, 5° FROM THE SUN, DURING TOTAL ECLIPSE OF JULY 20th, 1963

Francois Dossin and P. Swings *In its* Publ. of Goddard Space Flight Center, 1963, Vol. I [1963] p 44–45 (See N66-32006 18-30) GPO: HC $9.75; CFSTI: MF $7.50

During the total solar eclipse, observed in the Northeastern States (Maine), a systematic search for faint comets, close to the sun, has been carried out by means of several cameras, equipped with filters. On seven plates, a non-stellar object, which exhibits cometary characteristics, has been found. Author

N66-32010*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.

JEANS' CRITERION OF GRAVITATIONAL INSTABILITY

Su-shu Huang *In its* Publ. of Goddard Space Flight Center, 1963, Vol. I [1963] p 59–62 (See N66-32006 18-30) GPO: HC $9.75; CFSTI: MF $7.50

The physical ideas underlying Jeans' criterion of gravitational instability are examined, without delving deeply into the mathematical calculations. Jeans' formula is derived and the consequences of gravitational instability are extended to the origin of the Milky Way. H.S.W.

N66-32011*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.

RECENT ADVANCES CONCERNING THE EARLY HISTORY OF THE SOLAR SYSTEM

Su-shu Huang *In its* Publ. of Goddard Space Flight Center, 1963, Vol. I [1963] p 71–76 (See N66-32006 18-30) GPO: HC $9.75; CFSTI: MF $7.50

Investigations into the origin of the solar system are discussed. The formation of heavy elements is traced to the debris from the explosion of first generation stars. Clues to the early history of the solar system as derived by Fowler et al. are reviewed, and Hayashi's theory of pre-main sequence stars is examined. H.S.W.

N66-32012*# Chicago Univ., Ill. Enrico Fermi Inst. of Nuclear Studies.

ALUMINUM-26 IN IRON METEORITES AND THEIR COSMIC-RAY EXPOSURE AGES

Michael E. Lipschutz and Edward Anders *In* NASA, Goddard Space Flight Center Publ. of Goddard Space Flight Center, 1963, Vol. I [1963] p 113–123 refs Supported in part by NSF and AEC (See N66-32006 18-30) GPO: HC $9.75; CFSTI: MF $7.50

The Al^{26} and Ti^{44} contents of 10 iron meteorites were determined by γ–γ coincidence counting of separated fractions. The Al^{26} contents, ranging from 0 to 2.84 dpm/kg, were lower by factors of 1.5 to 3 than literature values obtained by β-counting. This discrepancy is apparently caused by a β-emitting impurity that interferes in β-counting, but not in the γ–γ coincidence method. From the Ne^{21} content of these meteorites, the following cosmic-ray exposure ages, in million years, were calculated (relative to Grant = 640 m.y.): Anspe = 110, Aroos = 950, Duchesne = 170, Norfolk = 530, Odessa = 360, Sandia Mountains ≥70, Santa Apolonia = 670, Sikhote-Alin = 330, Treysa = 400. In most cases, these values agree rather well with previously determined K^{40}/K^{41} and Cl^{36}/Ar^{36} ages. Except for the observed falls Aroos, Sikhote-Alin, and Treysa, none of the above meteorites contained any detectable Ti^{44} activity. Evidently the terrestrial ages of these meteorites are long compared to the half-life of Ti^{44}, ~150 y. The absence of Ti^{44} activ-

ity in Norfolk shows that it cannot have been associated with a 1907 fireball, as had been previously supposed. Author

N66-32013*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

EVOLUTION OF O STARS. I: HYDROGEN BURNING

Richard Stothers *In its* Publ. of Goddard Space Flight Center, 1963. Vol. I [1963] p 133–141 refs (See N66-32006 18-30) GPO: HC $9.75; CFSTI: MF $7.50

The evolution of an O-type star of 30 M ⊙ is considered from its initial main-sequence state to the point where the hydrogen content of the core has decreased from 70% to 7% by weight. The O stars are characterized by convective instability in the envelope and the full CNO-cycle of energy generation. Radiation pressure is important throughout the star, and electron scattering dominates the opacity. The inhomogeneous models consist of four zones: (1) a radiative envelope retaining the initial composition, (2) an outer semiconvective zone with a continuously varying composition that has a discontinuity at the interface with (3) an inner radiative zone also with a continuously varying composition, and (4) a homogeneous convective core. Due to increasing radiatioe pressure, the semiconvective zone grows more rapidly outward then inward, but produces little effect on the important stellar quantities. The mass fraction of the core decreases from 0.60 to 0.34 and the mean hydrogen content of the star gets 40% depleted. The age, 4.7 million years, is shorter than that four other sequences computed for stars of mass ~30 M⊙ because of a higher luminosity. This is mainly the result of choosing a higher mean molecular weight and CNO content. Author

N66-32014*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

AN ANALYTICAL REPRESENTATION OF MUSEN'S THEORY OF ARTIFICIAL SATELLITES IN TERMS OF THE ORBITAL TRUE LONGITUDE

Ann E. Bailie and David Fisher *In its* Publ. of Goddard Space Flight Center, 1963. Vol. I [1963] p 168–185 refs (See N66-32006 18-30) GPO: HC $9.75; CFSTI: MF $7.50

Analytic solutions to order k_2 of the differential equations of Musen's theory of artificial satellites are presented. These solutions include long-period terms and terms with small divisors derived from the k_2^2 approximations as well as from the third and fourth harmonics of the earth's potential. The results obtained herein may be used for computing orbits of artificial satellites to the first order, for checking the machine programming of the numerical theory, and for comparing Musen's theory with other artificial satellite theories. In addition, these results may be incorporated into the numerical theory to broaden its applicability, particularly in the case of nearly circular orbits. Author

N66-32016*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

HYPOTHETICAL FOUR-BODY PROBLEM AND ITS APPLICATIONS: AN ESTIMATE OF THE EFFECT OF THE MOON AND THE SUN ON THE SYNCOM ORBIT

Su-shu Huang *In its* Publ. of Goddard Space Flight Center, 1963. Vol. I [1963] p 260–268 refs (See N66-32006 18-30) GPO: HC $9.75; CFSTI: MF $7.50

A hypothetical system has been constructed by assuming that the center of mass of two finite bodies which are revolving around each other in circular orbit is itself circling with a third finite body at a large distance around the center of mass of the entire system. This somewhat artificial system is an idealization of the earth–moon–sun system. Thus, any satellite that moves in the latter system may be treated, as an approximation, as an infinitesimal fourth body in the hypothetical system, thereby constituting a hypothetical four-body problem. An investigation of the energy integral of the hypothetical four-body problem confirms that the motion of an artificial satellite in the earth–moon–sun system may be treated with a good approximation, as two three-body problems. An application of the problem thus formulated is found in the study of the general behavior of the Syncom orbit in the presence of the moon as well as the sun. It appears that the presence of both destroys the perfect synchronization of the axial rotation of the earth and the revolution of the Syncom satellite around it. It appears that the period of the fourth body around the earth fluctuates with the relative motion of the sun with respect to the earth–moon system. However, the deviation from the perfect synchronization is exceedingly small as would be expected and has no practical significance. Author

N66-32017*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

SATELLITE ORBIT ANALYSES FOR GEODETIC PURPOSES

W. M. Kaula *In its* Publ. of Goddard Space Flight Center, 1963. Vol. I [1963] p 326–329 refs (See N66-32006 18-30) GPO: HC $9.75; CFSTI: MF $7.50

The difficulties in obtaining accurate determinations of tracking station positions and longitudinal variations of the earth's gravitational field are not problems of mechanics, but rather of data analysis; nonuniform distribution of observations, inadequacy of the mathematical model of the atmosphere, and similarity of effects of different parameters on the same orbit. Because the characteristic periodicities of the geodetic effects fall in a different part of the spectrum of orbital variations from drag effects, the geodetic effects should, in theory, be determinable even though appreciably smaller. Given a statistical model for drag effects, a generalization of linear autoregression theory can be developed, which indicates that, in the computation, arrays of dimensions on the order of the number of observations must be manipulated. Hence either the number of observations treated must be limited or the rigorous treatment modified. The second alternative has been applied in analyzing Baker–Nunn camera observations of satellites 1959α-1, 1959η-1, 1960ι-2, in which various empirical methods are applied in place of allowing for the correlation between different observations. Some preliminary results obtained from 1960ι-2 are presented. Author

N66-32019*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

ORBIT PREDICTION ACCURACY THEORY

H. H. Montgomery, R. C. Blanchard, and F. Whitlock *In its* Publ. of Goddard Space Flight Center, 1963. Vol. I [1963] p 343–360 refs (See N66-32006 18-30) GPO: HC $9.75; CFSTI: MF $7.50

This document presents the development of equations which may be used to estimate the attainable accuracy of an orbit prediction. Given a schedule of observations with the corresponding standard deviations of the measurements and an orbit defined by the orbital elements a, e, i, ω, t_p, Ω the equations may be used to estimate the accuracy to which the orbit may be determined. Specifically, these equations may be used to estimate the variance–covariance matrix of the orbital elements for a specific tracking schedule from which the standard deviations of the orbital elements may be calculated. In addition, the method of calculating the confidence ellipsoid of position and velocity is shown. These are diagonalized matrices whose diagonals give the principal values of the variances in both position and velocity, respectively. The eigenvectors are calculated to give the direction of the ellipsoids with respect to an orbital plane coordinate

system. The analysis is done for a variety of observations which include range, range rate, azimuth, elevation, and the mini-track direction cosines. The weighted least squares criterion is used to establish the relationship between the corrections in the orbital elements and the observational errors, that is, the residuals. The required partial derivatives are calculated in closed form from two-body elliptical orbit theory. Author

N66-32020*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

ON DETERMINING THE SECULAR AND CRITICAL EFFECTS IN THE MOTION OF SATELLITES BY MEANS OF A NONSINGULAR SET OF VECTORIAL ELEMENTS

Peter Musen *In its* Publ. of Goddard Space Flight Center, 1963, Vol. I [1963] p 361–366 refs (See N66-32006 18-30) GPO: HC $9.75; CFSTI: MF $7.50

Under the influence of the sun and the moon a highly eccentric orbit of a satellite can become a nearly circular one or a nearly circular orbit might become eccentric. In light of this a combination of the Gibbsian rotation vector and the Hamiltonian vector is suggested as a nonsingular set of elements to be used for all eccentricities and all inclinations. The method of Halphen is suggested for the computation of secular effects, and the method of Liouville for the computation of the near resonance effects caused by the commensurability of mean motions of the disturbed and the disturbing body. The combination of these two methods can give information about the general behavior of the orbit of a minor planet over an interval of some thousands of years, and of an artificial satellite moving in cislunar space over an interval of a number of years. Author

N66-32021*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

ON THE GENERAL PLANETARY PERTURBATIONS IN RECTANGULAR COORDINATES

Peter Musen and Lloyd Carpenter *In its* Publ. of Goddard Space Flight Center, 1963, Vol. I [1963] p 454–461 refs (See N66-32006 18-32) GPO: HC $9.75; CFSTI: MF $7.50

A theory of general planetary perturbations in rectangular coordinates is developed. Expansion of the potential in terms of multipoles and application of operator calculus yield a direct and automatic way of forming the equations for the perturbations of any order. The perturbations in the position vector are decomposed along the instantaneous position and velocity vectors of the undisturbed motion and along the normal to the plane of the undisturbed motion. This decomposition leads to a direct method of integration and final formulas that are in a convenient form for programming. Author

N66-32032*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

THE RELATION OF TEKTITES TO LUNAR IGNEOUS ACTIVITY

Paul D. Lowman, Jr. *In its* Publ. of Goddard Space Flight Center, 1963, Vol. I [1963] p 1215–1227 refs (See N66-32006 18-30) GPO: HC $9.75; CFSTI: MF $7.50

The theory that tektites are of lunar origin has frequently been criticized on the grounds that rocks of this chemical composition could not have been formed on the moon. The purpose of this paper is to show that tecktites may have been derived from silicis igneous rocks, specifically rhyolitic tuffs, forming the upper layers of the maria. The essentially igneous nature of tektites is indicated by their bulk composition, their restricted compositional range, and the high probability that they have not been derived from sedimentary rocks by random processes such as meteoritic impact. The differences between tektites and normal igneous rocks probably reflect their formation by extremely high temperature fusion of previously solid igneous rock. It is shown that if the moon originally had a chondritic composition, the fusion curve of the lunar material should intersect the thermal gradients computed at the present time at 400 to 500 km depth, depending on the slope of the fusion curve, even if the moon had originally been at 0°C. Additional heat sources such as the kinetic energy of accretion and capture-induced internal friction would probably have raised the temperature well above the cold moon gradient. Magmas generated by partial fusion of the assumed chondritic material should be basaltic. It is proposed that the maria are the lunar equivalents of terrestrial lopoliths such as the Bushveld and Sudbury complexes. Author

N66-32034*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

THE ORIGIN OF THE ATMOSPHERES OF VENUS AND THE EARTH

A. G. W. Cameron *In its* Publ. of Goddard Space Flight Center, 1963, Vol. I [1963] p 1337–1345 refs (See N66-32006 18-30) GPO: HC $9.75; CFSTI: MF $7.50

Evidence regarding the Earth's atmosphere is reviewed and it is concluded that there are no detectable traces of the primitive solar nebula surviving in it. Evidence concerning the Venus atmosphere is analyzed and it is concluded that it probably contains of the order of 100 times the amount of nitrogen in the Earth's atmosphere and negligible amounts of water vapor. It is very difficult to see how the two atmospheres can have had a common origin, and it is proposed that the bulk of the Venus atmosphere is a remnant of the primitive solar nebula. In order to account for the absence of primitive gases from the Earth's atmosphere, a modified form of the Darwin–Wise hypothesis is proposed, according to which the Moon is formed as a result of the Earth's rotational instability induced for formation of the iron core. During such rotational instability the primitive gases would be entirely lost. A discussion is given of the circumstances surrounding the period of rotational instability. Author

N66-32039*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

STRUCTURE OF PLANETARY ATMOSPHERES

S. I. Rasool *In its* Publ. of Goddard Space Flight Center, 1963, Vol. I [1963] p 1464–1485 refs (See N66-32006 18-30) GPO: HC $9.75; CFSTI: MF $7.50

The properties of the atmospheres of Mars, Venus, and Jupiter are reviewed in the light of the observational results stemming from intensified research activity in the field of planetary atmospheres. Temperature is the most significant parameter in studying planetary atmospheres, and as an aid to the discussion, the temperature structure of the Earth's atmosphere is examined. In order to fit the observed data, new model atmospheres for the planets considered were derived. The discussion of these models includes, atmospheric composition and pressure, vertical distribution of temperature, upper atmosphere and ionosphere, and radiation belts. H.S.W.

N66-32112*# California Inst. of Tech., Pasadena.

NUCLEOSYNTHESIS IN THE EARLY HISTORY OF THE SOLAR SYSTEM

D. S. Burnett, William A. Fowler, and F. Hoyle (Cambridge Univ.) 31 May 1965 72 p refs AID Preprint Ser. in Nucl. Geophys.
(Grant NGR-05-002-028; Contract Nonr-220(47))
(NASA-CR-67873) CFSTI: HC $2.50/MF $0.75 CSCL 03B

This paper revises the nuclear calculations of the Fowler, Greenstein, and Hoyle model for the nucleosynthesis of D, Li, Be, and B by high energy particles from the sun during the early history of the solar system. These calculations are generalized in an approximate manner to include the irradiation time dependence caused by the long life of Be^{10}, and estimates are made of the remaining uncertainties. The consequences of the revised calculations were followed, particularly the effects of the nuclear irradiation on nuclei other than the above. The analysis of experimental data on the isotopic abundances of these elements leads to specific astrophysical conditions which must be met to retain the model. These conditions could provide the basis by which future space and meteorite research can decide what role nuclear physics has played in the formation of the solar system. Author

N66-32113*# California Inst. of Tech., Pasadena.
ON THE FORMATION OF ELLIPTICAL GALAXIES
F. Hoyle and J. V. Narlikar (Cambridge Univ.) [1965] 18 p refs AID Preprint Ser. in Nucl. Astrophys.
(Grant NGR-05-002-028; Contract Nonr-220(47))
(NASA-CR-67786) CFSTI: HC $1.00/MF $0.50 CSCL 03B

This paper suggests that the condensation of elliptical galaxies depends on the presence of inhomogeneities, particularly that a galaxy is formed around a central mass concentration. Because the Einstein–de Sitter expansion law is the limiting case between expansion to infinity at finite velocity and a fullback situation, in which expansion stops at some minimum but finite density, a central condensation with mass less than that of the associated galaxies prevents continuing expansion. The emissivity, assumed to follow the mass distribution follows an $r^{-8/3}$ law, resulting in a dependence on $r^{-5/3}$ when projection against the sky is considered. This law applies outside a central region with a radius of 30 parsecs. These considerations apply to a spherically symmetric case. Slight deviations from a spherically symmetric expansion can be discussed by introducing a local rate of strain tensor, ϵ_{ij}. The resulting galaxy is ellipsoid with principal axes in the direction of ϵ_{ij}. Unless set up by gas accretion, the galaxies do not rotate. Ellipticities of the isophotal contours of the projected image should be closely constant, with a slight increase outwards. Cases of high ellipticity may be rare. R.N.A.

N66-32116*# Sperry Gyroscope Co., Great Neck, N. Y.
PROGRAMMERS MANUAL FOR GODDARD ORBIT DETERMINATION PROGRAM
Apr. 1965 343 p refs
(Contract NAS5-3509)
(NASA-CR-64931; AB-1210-0038-3) CFSTI: HC $3.00/MF $0.75 CSCL 22C

A manual for a FORTRAN IV-coded program to calculate orbit trajectories, useful to both programmer and subroutine user, is presented. The manual supplements listings by providing definitions of terms in common, and terms found only within a subroutine, as well as detailed flow diagrams of each subroutine. A brief general description of the operational subprograms comprising the complete orbit determination and trajectory generation program is given; a system description of the over-all program flow in the minimum variance method is provided, and details of matrix manipulation are included for certain cases. Details of tape formats are listed for the over-all program flow in the Bayes estimation method. R.L.

N66-32121*# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.
CONTROL OF THE RELATIVE MOTION BETWEEN SATELLITES IN NEIGHBORING ELLIPTIC ORBITS
William R. Davis (Ph.D. Thesis) May 1966 190 p refs
(Grant NsG-582)
(NASA-CR-76585; SUDAAR-274) CFSTI: HC $3.25/MF $1.25 CSCL 22C

The relative translational motion control and motion stability between satellites in neighboring elliptical orbits is investigated in terms of transition matrices. The nature of the translation motion is expressed in the fundamental matrix solution to the differential equations of motion; the fundamental matrix for the orientation of a free body in terms of Euler parameters is developed and presented. A solution to the translative control of a satellite that is altitude controlled to local level is given in a system which actively controls the relative translation motion of the vehicle relative to the proof mass along one axis only. Results of the problem investigated on minimizing limit cycle fuel consumption in the presence of noise in the relative position sensor are displayed in a series of graphs. Emphasis is on the technique to treat the drag make-up satellite in which satellite air drag is compensated for by continuously thrusting an outer satellite so that it never touches an inner proof mass. R.Li.

N66-32181# Maryland Univ., College Park. Dept. of Physics and Astronomy.
DENSITY OF ZODIACAL DUST IN INTERPLANETARY SPACE
John W. Rhee (Rose Polytechnic Inst.) Jul. 1966 12 p refs
(Grant NSF GY-670)
(TR-581)

A further analysis of the Mariner II and the Mariner IV data seems to indicate that the particle number density varies from 10^{-16} to 10^{-14} particle per cm^3 and the spatial density ranges from 10^{-26} to 10^{-24} gram per cm^3 between 0.72 A.U. and 1.56 A.U. Author

N66-32193# Kyoto Univ. (Japan).
PHOTOGRAPHIC ATLAS OF THE MOON, SECOND EDITION, 1964
S. Miyamoto and A. Hattori, ed. 1964 141 p Contrib. from Inst. of Astrophysics and Kwasan Obs. No. 137
CFSTI: HC $3.00/MF $1.00

Very good quality photographs of the lunar surface, obtained with cameras attached to the Cooke refractor and Tsugami reflector telescopes are presented. Descriptions of the telescopes and their cameras are given. The lunar surface was divided into 29 districts, the last 8 sections of which are libratory regions. For each section, morning, evening, and high sun photographs were selected. Maps for illustration are omitted. The purpose of this atlas is for the study of large scale geological features of the lunar crust, and not for lunar geodesy. L.S.

N66-32198# Minnesota Univ., Minneapolis. Observatory.
A SEARCH FOR FAINT BLUE STARS. XXXVI: PROPER MOTIONS FOR THIRTY-EIGHT ANCIENT NOVAE AND U GEMINORUM VARIABLES
William J. Luyten and Helen S. Hughes 30 Apr. 1965 5 p refs
(Contract Nonr-1892(00))
(AD-619658) CFSTI: HC $1.00/MF $0.50

Using very good photographic plate samples for the search, proper motions were determined for 25 stars of the U Geminorum type, and for 13 ancient novae. The data obtained are presented in a table and include: (1) the star's name,

(2) the position for 1950, (3) the photographic magnitude at minimum, (4) the total number of plates used, (5) the maximum interval in years, (6) the number of comparison stars used and their mean, apparent photographic magnitude, (7) the measured relative motion, (8) the adopted correction from relative to absolute, and (9) the final components of the absolute motion with their estimated mean errors. The data will be used together with spectroscopic data to be analyzed for the solar motion and luminosities of the stars. Some comments on the magnitudes of the stars on the plates are given here. L.S.

N66-32220# Boeing Co., New Orleans, La. Launch Systems Branch.

AN INDIRECT METHOD FOR COMPUTING EXTREMAL ROCKET BOOSTER TRAJECTORIES IN AN INVERSE-SQUARE FORCE FIELD

David F. Williams and Kenneth M. Proctor 19 Apr. 1966 189 p refs

(D5-13223; AD-482301)

An implementation of the indirect calculus of variations techniques for the numerical solution of extremal multistage rocket booster trajectories in an inverse-square force field is described. The booster is constrained to two-dimensional vacuum flight, and both the flight path and coasting arcs are optimized so that propellant consumption is a minimum. Several numerical solutions are presented, and a complete description of the computing tool is provided. Author (TAB)

N66-32255*# Arizona Univ., Tucson.

COMMUNICATIONS OF THE LUNAR AND PLANETARY LABORATORY, VOLUME 4, PART 3: UBVRIJKL PHOTOMETRY OF THE BRIGHT STARS

H. L. Johnson, R. I. Mitchell, B. Iriarte, and W. Z. Wisniewski 1966 157 p refs *Its* Commun.-63

(Grant NsG-161)

(NASA-CR-76683) CFSTI: HC $3.25/MF $1.00 CSCL 03A

We present here the results of our multicolor photometric work on the bright stars. Of the stars listed in the Catalogue of Bright Stars, we have observed 1567 in U,B,V,R, and I; 653 in J and K; and 268 in L. Comparisons of our new UBV measures with previously published data on the same system indicate that the quality of our data is high. We have found it possible to make a very accurate transformation of the southern Cape photometry to the UBV system; for this reason, we give here a catalog of UBV photometry on nearly 5000 bright stars over the entire sky. Author

N66-32266*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

GODDARD SPACE FLIGHT CENTER CONTRIBUTIONS TO THE COSPAR MEETING—MAY 1965

Washington, NASA, Jul. 1966 296 p refs Presented at the 5th Intern. Space Sci. Symp., Buenos Aires, May 1965

(NASA-TN-D-3091) CFSTI: HC $7.00/MF $1.50 CSCL 03A

CONTENTS:

1. RELATIVE ADVANTAGES OF SMALL AND OBSERVATORY TYPE SATELLITES G. H. Ludwig p 1–11 (See N66-32267 18-31)

2. THE NIMBUS I METEOROLOGICAL SATELLITE-GEOPHYSICAL OBSERVATIONS FROM A NEW PERSPECTIVE W. Nordberg p 13–33 refs (See N66-32268 18-31)

3. CONJUGATE INTERSECTS TO SELECTED GEOPHYSICAL STATIONS J. G. Roederer, (NAS-NRC), W. N. Hess, and E. G. Stassinopoulos p 35–131 refs (See N66-32269 18-13)

4. A SUMMARY OF RESULTS FROM THE IMP-1 MAGNETIC FIELD EXPERIMENT J. M. Wilcox (Calif. Univ.), N. F. Hess, C. S. Scearce, and J. B. Seek p 133–170 refs (See N66-32270 18-30)

5. SOUTHERN HEMISPHERE ANOMALIES J. G. Roederer (NAS-NRC) p 171–182 refs (See N66-32271 18-13)

6. THE GENERAL FOKKER-PLANCK EQUATION FOR TRAPPED ELECTRON DIFFUSION J. G. Roederer (NAS-NRC) and J. A. Welch (AFSC) p 183–207 refs (See N66-32272 18-29)

7. THE NEUTRON FLUX IN SPACE FOLLOWING A POLAR CAP NEUTRON EVENT ON NOBEMBER 15, 1960 E. L. Chupp (New Hampshire Univ.), C. Curry (Calif. Univ.), and W. N. Hess p 209–220 refs (See N66-32273 18-29)

8. HEAT BUDGET OF THE SOUTHERN HEMISPHERE S. I. Rasool and C. Prabhakara p 221–232 refs (See N66-32274 18-13)

9. SOME ENERGY IMPLICATIONS OF DIRECT MEASUREMENTS OF THERMOSPHERE STRUCTURE G. R. Carignan, D. R. Taeusch, H. Niemann (Mich. Univ.), N. W. Spencer, and L. H. Brace p 233–240 refs (See N66-32275 18-13)

10. LATITUDINAL VARIATIONS OF ELECTRON TEMPERATURE AND CONCENTRATION FROM SATELLITE PROBES L. H. Brace and B. M. Reddy p 241–255 refs (See N66-32276 18-13)

11. ROCKET OBSERVATIONS OF THE STRUCTURE OF THE MESOSPHERE W. Nordberg, L. Katchen, J. Theon, and W. S. Smith p 257–274 refs (See N66-32277 18-13)

12. THE IN-SITU DETECTION OF THE MID-LATITUDE Sq CURRENT SYSTEM K. Burrows and S. H. Hall (Imperial Coll. of Sci. and Tech.) p 275–288 refs (See N66-32278 18-13)

13. ROCKET MEASUREMENTS OF MIDLATITUDE Sq CURRENTS T. N. Davis, J. D. Stolarik, and J. P. Heppner p 289–299 refs (See N66-42279 18-13)

14. NEUTRON STARS AS X-RAY SOURCES H.-y. Chiu p 301-305 refs (See N66-32280 18-30)

N66-32270*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

A SUMMARY OF RESULTS FROM THE IMP-I MAGNETIC FIELD EXPERIMENT

N. F. Hess, C. S. Scearce, J. B. Seek, and J. M. Wilcox (California Univ.) *In its* Goddard Space Flight Center Contrib. to the COSPAR Meeting, May 1965 Jul. 1966 p 133–170 refs (See N66-32266 18-30) CFSTI: HC $7.00/MF $1.50

The interplanetary monitoring platform (IMP-I) launched in November 1963 with an apogee of 31.7 R_e, has provided the first accurate measurements of the interplanetary magnetic field, the magnetosphere boundary and the collisionless magnetohydrodynamic shock wave associated with the solar wind interaction with the geomagnetic field. The shape of the magnetosphere is found to be roughly cylindrical in shape, diameter = 44 R_e. The average direction of the interplanetary field is approximately 140° east of the earth–sun line or 60° west of the sun. Author

N66-32280*# National Aeronautics and Space Administration. Goddard Inst. for Space Studies, New York.

NEUTRON STARS AS X-RAY SOURCES

H.-Y. Chiu *In* NASA. Goddard Space Flight Center Goddard Space Flight Center Contrib. to the COSPAR Meeting, May 1965 Jul. 1966 p 301–305 refs (See N66-32266 18-30) CFSTI: HC $7.00/MF $1.50

The density of neutron stars is approximately 10^{14} g/cm^3, with a typical radius of 10 km. At such a high density, the Fermi energy of electrons is of the order of a few hundred MeV, in

which the gas is mainly composed of neutrons, thus, nuclei cannot exist. Thought to be a remnant of supernova processes, the neutron star, formed at a temperature > 10^{10} °K, cools down, in a matter of a few weeks via neutrino processes, to a temperature of about 5 × 10^{8} °K. Henceforth, the loss of energy is through surface blackbody emission with a luminosity in the range of 1 $L_{\odot}$ to 10^{3} $L_{\odot}$. This corresponds to a surface temperature of 10^{6} — 10^{7} °K, where most energy is in the wavelength band of 1 Å — 10Å. Neutron stars are, therefore, potential cosmic x-ray emitters if they exist. The radiation characteristics of neutron star type x-ray sources is also discussed. We have found that the source Scorpius X-1 (ScXR-1) is the most likely selection and further measurements on the angular diameter of this source will be fruitful. Author

N66-32292*# IIT Research Inst., Chicago, Ill. Astro Sciences Center.

[STUDIES AND ANALYSES OF SPACE SCIENCE PROBLEMS RELATED TO THE PLANNING AND DIRECTING OF NASA LUNAR AND PLANETARY PROGRAMS] Third Annual Summary Report, Jul. 1965–Jun. 1966

Jun. 1966 74 p refs

(Contract NASr-65(06))

(NASA-CR-76732; A-3) CFSTI: HC $2.50/MF $0.75 CSCL 22A

Reports and projects on management and planning problems relating to NASA lunar and planetary programs are summarized, and a complete bibliography is included. The report categories include annual summary reports, cost estimation methods, mission programming, objectives of advanced missions, success probability determinations, spacecraft technology, general trajectory studies, and project scheduling. Some of the specific topics covered are missions to the comets, telemetry communications guideline, low-thrust trajectory capabilities, satellites of Mars, critical measurements on early missions to Jupiter, and analytical methods and observational requirements for interpretation of asteroid distributions. L.E.W.

N66-32298*# Harvard Coll. Observatory, Cambridge, Mass.

A STUDY OF THERMAL RESPONSE OF THE LUNAR SURFACE AT THE LANDING SITE DURING THE DESCENT OF THE LUNAR EXCURSION MODULE (LEM)

Jerome T. Holland and Hector C. Ingrao 1 Apr. 1966 58 p refs Prepared for Arthur D. Little, Inc. and NASA

(Grant NsG-64-60)

(NASA-CR-76648) CFSTI: HC $2.50/MF $0.50 CSCL 03B

This report analyzes the thermal response of the lunar surface at the landing site due to the radiative and convective heat transfer from the LEM exhaust nozzle. A computer program has been written to analyze the thermal transients as a function of (1) the thermal model of the lunar surface materials; (2) depth beneath the lunar surface; (3) distance from the touchdown point. The physical meaning of the answers obtained in our analysis depends on how accurate the heat transfer parameters are for the assumed model, during the LEM descent. Therefore we prefer to stress the method of analysis rather than the numerical conclusions. Author

N66-32300*# Bellcomm, Inc., Washington, D. C.

PHOTOMETRY AND POLARIMETRY OF THE MOON AND THEIR RELATIONSHIP TO THE PHYSICAL PROPERTIES OF THE LUNAR SURFACE Summary

C. A. Pearse 23 Aug. 1963 8 p

(Contract NASw-417)

(NASA-CR-76695; TR-63-211-7) CFSTI: HC $1.00/MF $0.50 CSCL 03B

Experimental and theoretical information relating to the photometry of the moon is reviewed, with emphasis given to the salient lunar light reflecting properties which are controlled by the exact nature of the lunar surface microrelief. A lunar covering surface model is briefly described, and compared to conclusions based on photometric data. Certain types of information that cannot be obtained from an analysis of lunar photometric, polarimetric, and colorimetric data are listed. It was concluded that the lunar surface is covered, at least to millimeter depth, with an intricate matrix made up of small adhesive grains, probably resulting from pulverization of lunar surface material by micrometeoroid bombardment. L.E.W.

N66-32302*# Southwest Center for Advanced Studies, Dallas, Tex.

THE ATMOSPHERE OF MARS

Francis S. Johnson [1966] 16 p refs Presented at the COSPAR 7th Intern. Space Sci. Symp., Vienna, 10–19 May 1966

(Grant NsG-269)

(NASA-CR-76666) CFSTI: HC $1.00/MF $0.50 CSCL 03B

Much new information has become available in recent years on the Martian atmosphere. Mariner IV data have shown that the surface pressure is below ten millibars, a result that is not inconsistent with the most recent spectroscopic studies. If the Mariner IV ionospheric data are interpreted in terms of an F2 peak, the atmosphere must be very cold at all levels and the exospheric temperature must be near 85°K. This result is in disagreement with studies of radiative equilibrium temperatures, which indicate a relatively warm exosphere, the temperature being in the vicinity of 400°K. As a consequence of this inconsistency and others of a similar nature, there is still a wide range of speculation concerning the properties of the Martian atmosphere. These inconsistencies will probably be resolved only after more detailed observations have been made in planetary probes, such as the distribution of resonance scattering of sunlight by atomic oxygen. Author

N66-32317# Lund Observatory (Sweden).

COMPARISONS BETWEEN MK, HD AND HDE SPECTRAL CLASSES

Ulf Lindoff and Goesta Lynga 1966 38 p refs Presented at Royal Physiographic Soc., 14 Mar. 1966 *Its* Acta Univ. Lundensis, Sectio II, No. 22

CFSTI: HC $2.00/MF $0.50

Comparisons have been made between the classification system of the Henry Draper Catalogue with Extensions and the Morgan–Keenan system as used by different classifiers. In order to determine spectral class difference with mean errors, the concept of class width is introduced, reflecting the frequency with which a spectral subclass has been used. The basic material consists of 9648 stars from a recent collection of data by Jaschek, Conde and Sierra. The differences between the classification systems are studied as functions of apparent magnitude, luminosity class and, for early type stars, of galactic latitude. The main result is a set of diagrams which can be used for conversion from the HD(E) to the MK system. In two tables the systematic differences are given between stars of different luminosity classes. The classification differences show a slight variation with galactic latitude. The presumption that this is due to a correlation between classification and interstellar reddening is not confirmed. It is also found that stars without subclass in the HD(E) as an average belong to the earliest subclass of their assigned HD(E) class. Author

N66-32328*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

A COMPUTATIONAL METHOD FOR TWO-IMPULSE ORBITAL RENDEZVOUS AND TRANSFER PROBLEMS

Robert L. Collins and Sylvia A. Wallace Washington, NASA, Aug. 1966 86 p refs

(NASA-TN-D-3508) CFSTI: HC $3.00/MF $0.75 CSCL 22C

A detailed derivation of exact equations and an associated computer program with which the basic parameters involved in transfer or rendezvous between two arbitrary elliptic orbits may be calculated are presented. The computations are exact in the sense that the Kepler solutions for bodies orbiting in a point-gravity field are used. This method deviates from the classical approach based on the theorem of Lambert, inasmuch as it uses the true anomaly and the Kepler equations for iterating to the desired rendezvous transfer time. The method has a unique feature in that definite boundaries, dependent on the problem input, are used which limit the range of the true anomaly, and thereby reduce the search effort required in the iteration procedure. The program provides for a solution to problems where the transfer angle is less than 360°. Examples are given for three particular uses of the program: (1) interplanetary transfer between massless planets, (2) near-planet orbit rendezvous, and (3) orbital transfer. Author

N66-32337*# TRW Systems, Redondo Beach, Calif.

N-BODY MONTE CARLO SIMULATION OF SPECIFIC LUNAR ORBITER MISSIONS

J. J. Cohen and D. C. Leonard 1 Mar. 1966 363 p refs

(Contract NAS1-4605)

(NASA-CR-66055; TRW-2854-6015-RO-000) CFSTI: HC $4.25/MF $2.00 CSCL 22A

This study demonstrated the feasibility of performing n-body precision integration dispersion analyses for a specific lunar orbiter mission. A space navigation simulation program was successfully adapted to simulate the specified lunar orbiter mission from translunar injection through two finite burn midcourse maneuvers, two finite burn deboost maneuvers, and ten passes over the specified photographic target latitude. The nominal trajectory was targeted to achieve the desired photographic orbit characteristics and a targeting procedure was mechanized to compute the required finite burn maneuvers for trajectory dispersions about the nominal. Thirty complete launch-to-mission-completion Monte Carlo dispersed lunar orbiter sample missions were generated incorporating the guidance law mechanized for the study, and the statistical results were presented in the most meaningful way. Author

N66-32409# Kyoto Univ. (Japan).

METEOROLOGICAL OBSERVATIONS OF MARS DURING THE 1965 OPPOSITION

S. Miyamoto 1965 68 p refs Contrib. from the Inst. of Astrophys. and Kwasan Obs. No. 141

CFSTI: HC $2.50/MF $0.75

A report about the meteorological observations of Mars during the 1965 opposition is presented. In this opposition, meteorological phenomena at the transitional epoch from spring to summer circulation in the northern hemisphere were observed. The first section is concerned with the general appearance of surface markings in this opposition. The second section describes details of the summer clouds. In spring, observations were made of clouds associated with the polar front, and formation of dark fringe surrounding the polar cap. At the transitional epoch to summer, the atmosphere turned hazy but cloudless, and the shrinking rate of the polar cap reduced for a moment. In summer, clouds developed from certain definite places along the dark fringe, and drifted by the summer easterlies and reached the equator. In the third section, some interpretation was added about the clouds behavior relating to the general circulation of the Martian atmosphere. Author

N66-32410# Canterbury Univ., Christchurch (New Zealand). Dept. of Chemical Engineering.

MASS-TRANSFER OPERATIONS IN NEW ZEALAND

R. B. Keey 1965 26 p refs

CFSTI: HC $2.00/MF $0.50

A survey of current practice and possible trends in mass transfer operations in New Zealand is presented. This survey was designed to provide some insight into fields of needful research, and industry with a finding list of equipment and operations. Results from forty-one companies and institutes are given, and include reports from food processing industries, beverage industries, pulp and paper products, chemical and chemical products, non-metallic mineral products, petroleum and coal products, and various other processes. C.T.C.

N66-32411# Amsterdam Univ. (Netherlands).

21-CM OBSERVATIONS OF TWO STELLAR ASSOCIATIONS IN MONOCEROS. THE VELOCITY DISTRIBUTION OF ATOMIC HYDROGEN IN THE OUTER PARTS OF THE GALACTIC SYSTEM ACCORDING TO THE KOOTWIJK SURVEY 1953–65

Ernst Raimond and Olof Lindblad [1966] 83 p refs Bull. of the Astron. Inst. of the Netherlands Suppl. Ser., Vol. I, No. 2, Apr. 1966

CFSTI: HC $2.50/MF $0.75

The 25-meter telescope of the Dwingeloo radio observatory was used to obtain 21-cm line profiles in the area l^{II} = 192.3° to 212.3° (l^{I} = 160° to 180°), b^{II} = −9.5° to 8.5° (b^{I} = −8° to 10°). In the central part of this area the spacing between profiles is 0.5°, elsewhere it is 1°. A summary is given of the essential data of the telescope and receiver, followed by a brief description of the reduction of the observations. The Dwingeloo observations are compared with those obtained at five other observatories, with all radial velocities given with respect to the local standard of rest. C.T.C.

N66-32416# Bonn Univ. (West Germany). Astronomical Inst.

1964 YEARLY REPORT OF THE ASTRONOMICAL INSTITUTE OF THE UNIVERSITY OF BONN [JAHRESBERICHT 1964 DER ASTRONOMISCHEN INSTITUTE DER UNIVERSITAET BONN]

[1963] 14 p In GERMAN *Its* Rept.-63

CFSTI: HC $1.00/MF $0.50

The personnel and technical organization of the Astronomy Department at the University of Bonn, West Germany, is briefly outlined and the utilized buildings and instrumentations are described. The center reports physical work on measurements of the 21 cm line of hydrogen, the elastic deformation of plates by weight, the distribution of hydrogen in galaxies, on weak radio sources in galactic continuums, on solar radiation with burst registration, the motions of weak stars in selected areas of the galaxy, color measurements of stars, etc. Transl. by G.G.

N66-32428*# Smithsonian Astrophysical Observatory, Cambridge, Mass.

STUDY OF LUNAR EARTHSHINE BY PHOTOELECTRIC PHOTOMETRY Semiannual Report, 1 Nov. 1965–30 Apr. 1966

Fred A. Franklin Jun. 1966 18 p refs

(Grant NGR-09-015-025)

(NASA-CR-76753) CFSTI: HC $1.00/MF $0.50 CSCL 03B

Developmental work on a photoelectric photometer for measuring the earth's albedo is reported, and the observation techniques for instrument application are discussed. A study to provide V and B photoelectric observations of the earthshine that is not measured in terms of the sunlit lunar crescent, and to find the maximum lunar phase at which reliable measurements could be readily obtained is reported. The chosen regions were Mare Crisium for morning, and a region near but not including Aristarchus, in Oceanus Procellarum for evening observations. Tables and graphs of the photometric results are presented. It is concluded that the average Bond albedo of the earth is close to, or possibly less than, 0.36 in V, and it is suggested that it is about 20% higher in B. A.G.O.

N66-32429*# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.

THE ATTITUDE CONTROL OF A SATELLITE IN AN ELLIPTIC ORBIT

Ronald Busch and Irmgard Fluegge-Lotz Apr. 1966 42 p refs

(Grant NsG-133-61)

(NASA-CR-76751; SUDAAR-261) CFSTI: HC $2.00/MF $0.50 CSCL 22A

An attitude control system for a satellite in an elliptic orbit is developed. Linear time-varying equations are used to describe attitude motion; they are obtained by assuming that attitude angles and angular rates as well as orbital eccentricity are small. The desired attitude is such that one body-fixed axis is earth-pointing and another is normal to the orbital plane. Gas jet control torques and minimum fuel consumption are assumed. The Pontryagin maximum principle is used for optimal control, and the system is accordingly run in reverse-time. Although simple, the performance of the final system is near optimal for the ranges and values that were considered. For a satellite in an elliptic orbit and attitude equations written for an earth-pointing reference frame, the pitch equation contains a time-dependent forcing term. Continual steady-state control is obtained by adding a pitch reaction wheel. Analog and digital computer programs, used for simulation and equation integration, are included. K.W.

N66-32439*# IIT Research Inst., Chicago, Ill. Astro Sciences Center.

SCIENTIFIC OBJECTIVES OF DEEP SPACE INVESTIGATIONS—VENUS

P. Dickerman May 1966 57 p refs

(Contract NASr-65(06))

(NASA-CR-76766; P-7) CFSTI: HC $2.50/MF $0.50 CSCL 03B

The Venusian astronomical and orbital characteristics are summarized, and available physical and environmental data are reviewed in relation to developing models for the planetary environment. The methods and types of instrumentation used for the various measurements are discussed, and the relative advantages of each are weighed. These include visual and photographic observations, photometry, polarimetry, spectroscopy, infrared radiometry, microwave radiometry, radar reflectivity, and magnetometry. The way in which these data can be used to construct models for the planetary environment and interior is described, and several examples are given. Basic scientific questions which missions to the planet should answer are listed, and a set of measurements based on these questions is suggested. The type of data expected from each measurement is given, along with the minimum mission mode required to make the measurement. M.G.J.

N66-32440*# IIT Research Inst., Chicago, Ill. Astro Science Center.

A SURVEY OF MULTIPLE MISSIONS USING GRAVITY-ASSISTED TRAJECTORIES

J. C. Niehoff Apr. 1966 59 p refs

(Contract NASr-65(06))

(NASA-CR-76767; M-12) CFSTI: HC $2.50/MF $0.50 CSCL 22C

Gravity-assisted multiple missions to a number of specific solar system targets were briefly analyzed in order to assess the practical advantages these missions may have over direct missions to the same targets. The targets analyzed included Mercury, outer planets (Saturn and beyond), out-of-the-ecliptic regions, solar probes, reconnaissance (earth return), asteroids as a group and individually, comet rendezvous, and planetary satellites. Gravity-assisted and direct trajectories were restricted to ballistic flight. Six multiple missions are recommended for further study: Earth–Venus–Mercury; Earth–Jupiter–Saturn–Uranus–Neptune; Earth–Jupiter–90° out-of-the-ecliptic; Earth–Venus (single or multiple)–solar probe; Earth–Jupiter–solar probe; and Earth–Mars–asteroid fly-through. The launch opportunities, principal objectives, advantages over a direct mission, the ideal velocity, and the trip time for each are summarized. M.G.J.

N66-32471# Boeing Scientific Research Labs., Seattle, Wash. Plasma Physics Lab.

ELECTRICAL HAZARDS OF DOCKING IN SPACE

J. E. Drummond and D. J. Nelson Apr. 1966 46 p refs

(D1-82-0523)

If two earth satellites are joined by a conductor more than few meters long, the electromotive force generated by its cutting the earth's magnetic field can set up an electrical current. Calculations are presented for the conductor length necessary to cause this current to exceed the limit of physical endurance of an astronaut attempting to join the two satellites. The resistance of the magnetosphere to current flowing between two satellites connected by a cable is calculated. In addition, the nonlinear resistances of the sheaths surrounding the satellites are calculated by a modification of the double probe theory. The arm to arm resistance of humans is discussed when the skin of the arms is soaked by a saturated solution of salt water. The effective electrical resistance of the space charge sheath around a charged spherical vehicle in the shadow of the moon is computed. Other topics discussed are the current from a hot spot, the effective electrical resistance of a rocket exhaust, and the voltage produced by a charged exhaust. S.P.

N66-32529# Royal Astronomical Society, London (England).

RADIAL VELOCITIES OF SOUTHERN B STARS DETERMINED AT THE RADCLIFFE OBSERVATORY. IV: THE SCO–CEN ASSOCIATION

A. D. Thackeray Oxford, Blackwell Sci. Publications, 1966 24 p refs *Its* Mem., Vol. 70, Pt. 2

CFSTI: HC $1.00/MF $0.50

Newly observed radial velocities of seventy-three stars selected as members of the Sco-Cen association, are presented. (Table I). Previously published Radcliffe velocities of thirty additional such stars are quoted in Table II. Nineteen of the stars (forming fainter components of visual binaries) have no previously known velocities. The spectral types of these companions (a few of which appear to be optical) range from B to KO Ve. Special efforts have been made to secure accuracy in the measures of stars with diffuse lines through the use of dense exposures with contrasty emulsions. The average standard error is ±2.6 km/s for stars that are not clearly variable

in velocity. The velocities are compared with the Lick and Canberra determinations. A further discussion deals with the problem of border-line cases of variable velocity. Author

N66-32568# Library of Congress, Washington, D. C. Aerospace Technology Div.
SURFACE CHARACTERISTICS OF THE MOON, MARS, AND VENUS Annotated Bibliography
Joseph Javis and Daniel W. Michaels 16 May 1966 72 p refs
(ATD-66-53)

This annotated bibliography was compiled from Soviet-Satellite open sources published 1963–1966. It is the second report in a continuing series indicative of Soviet-bloc research of the surface characteristics of Mars, Venus, and the Moon with reference to light polarization and albedo measurement techniques and to radioastronomical investigations. The 110 bibliographic entries are listed alphabetically by author in four sections: I. The Moon (58 entries); II. Mars (28 entries); III. Venus (18 entries); IV. General (6 entries). An Author Index is included at the end of the report. Other information included: Photography of celestial bodies, photogrammetry, and photointerpretation in space investigations; usual formation on Venus; radar observations of Venus; Martian canals; Mars satellites; volcanic activity on Mars; colorimetric comparison of asteroids and terrestrial rocks. Author

N66-32592# Brown Engineering Co., Inc., Huntsville, Ala. Research Labs.
PERIODICITIES IN THE JOVIAN DECAMETRIC RADIO EMISSION
J. Randall Holmes Jul. 1966 126 p refs
(R-206)

Autocorrelation and power spectral density techniques have been applied to the Jovian activity index rate derived from data collected in Florida and Chile at 15, 18, and 22.2 MHz during the apparitions of 1960, 1961, 1962 and 1963. The long wavelength emission from Jupiter contains many periodic components. Those common to most of the data are the four 7–8, 17–18, 24–25, and 35-day periodicities. Attempts to isolate the cause of the irregularities have involved a search for correlation between these periodicities and the naturally occurring rotational periods of Jovian satellites and the radio sources which are presumably tied to the solid disk of the planet by its magnetic field. Periodicities in solar indices have also been examined. Author

N66-32639*# California Univ., Los Angeles. Inst. of Geophysics and Planetary Physics.
EVIDENCE FOR HYDROMATIC WAVES IN THE INTERPLANETARY PLASMA
Paul J. Coleman, Jr. 20 Apr. 1966 24 p refs *Its* Publ-997 (Grant NsG-249)
(NASA-CR-76945) CFSTI: HC $1.00/MF $0.50 CSCL 20I

Evidence is presented for the existence of magnetohydrodynamic waves in interplanetary space through measurements obtained with a flux-gate magnetometer and ion spectrometer, or plasma probe of the electrostatic analyzer type, on board the Mariner II spacecraft Efforts are aimed at showing that the properties of the variations observed in the magnetic field and plasma velocity satisfy certain necessary conditions of hydromagnetic wave behavior. Heliocentric spherical polar coordinates with the polar axis coincident with the sun's axis of rotation are employed. Amplitude distributions of the measured variables were examined, correlations between the various pairs of these variables were determined, and the cross spectra of each pair were estimated for several sections. Cross spectra results provide evidence for wave-like motions in the interplanetary plasma, and lead to a more quantitative comparison between observed properties and those expected for idealized hydromagnetic waves. Results of the comparison are summarized. S.P.

N66-32640*# California Univ., Los Angeles. Inst. of Geophysics and Planetary Physics.
VARIATIONS IN THE INTERPLANETARY MAGNETIC FIELD: MARINER 2. PART 3: SOME EFFECTS UPON SOLAR COSMIC RAYS
Paul J. Coleman, Jr. 12 May 1966 53 p refs *Its* Publ.-514 (Grant NsG-249)
(NASA-CR-76944) CFSTI: HC $2.50/MF $0.50 CSCL 20C

The observed properties of the variations in the interplanetary field, are employed in developing a model for the typical interplanetary field. Some properties of the behavior of solar protons in the model field are determined. It is shown that protons with energies less than 1 Mev would travel adiabatically throughout the solar system, protons with energies in the range 1–100 Mev would first encounter efficient scattering at heliocentric ranges beyond 1 AU, protons with energies in the range 100 Mev–1 bev would encounter efficient scattering at ranges near 1 AU, and protons with energies greater than 1 bev would first encounter efficient scattering at ranges less than 1 AU. It is argued that various properties of solar-proton events may be accounted for by this model. However, nonrelativistic solar-flare electrons would travel adiabatically throughout interplanetary space. It is shown that a good deal of the observed spread in the directions of travel of solar protons in the interplanetary field at the onset of an event is probably due to the variations in the orientation of the field rather than to a spread in particle pitch angles. Author

N66-32660# Lund Observatory (Sweden).
INVESTIGATIONS OF A REGION IN MONOCEROS. PART I: DETERMINATION OF MONOCHROMATIC MAGNITUDES AND HYDROGEN LINE DEPTHS OF B-TYPE, A-TYPE, AND F-TYPE STARS
Bengt Karlsson 1966 28 p refs *Its* Acta Univ. Sectio II, 1966, No. 4
CFSTI: HC $2.00/MF $0.50

From objective prism plates a monochromatic magnitude at 4400 Å and the central depths of Hγ and Hδ have been determined for 800 early type stars in a region in Monoceros. The limiting magnitude corresponds to B=12.5. The open cluster NGG 2264 is situated roughly in the centre of the region. In this paper the methods of determining the quantities mentioned are described. The results will be published in a subsequent paper. Author

N66-32668*# California Univ., Los Angeles. Inst. of Geophysics and Planetary Physics.
VARIATIONS IN THE INTERPLANETARY MAGNETIC FIELD: MARINER 2. PART 2: INTERPRETATION IN TERMS OF HYDROMAGNETIC WAVES
Paul J. Coleman, Jr. 5 May 1966 46 p refs *Its* Publ.-504 (Grant NsG-249)
(NASA-CR-76943) CFSTI: HC $2.00/MF $0.50 CSCL 03B

Some characteristics of the variations of the interplanetary magnetic field and the plasma velocity, observed during the flight of Mariner 2, are considered. First, properties of the power spectra from records of the plasma velocity and the three vector components of the field are described. Next, the properties of the cross spectra between pairs of this set of four variables are described. The variations that would be produced in the plasma velocity and the field components by

hydromagnetic waves are determined from a model of a uniform, perfectly conducting, isentropic, ideal gas in a uniform magnetic field. The properties of the variations determined empirically, are compared with those determined from this model. Author

31 SPACE VEHICLES

Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see: 30 Space Sciences. For related information see also: 28 Propulsion Systems; and 32 Structural Mechanics.

N66-31496*# National Aeronautics and Space Administration, Washington, D. C.

GOALS OF THE VOYAGER PROGRAM

Robert Fellows *In* VPI Proc. of the Conf. on the Exploration of Mars and Venus Aug. 1965 12 p (See N66-31486 18-30) CFSTI: HC $7.00/MF $1.75

The various types of scientific investigations to be conducted when exploring a new planet are summarized, and the objectives which a spacecraft system and its scientific payload should be capable of achieving are listed. The results of early Voyager studies are summarized for the flyby (Mariner II and IV), the orbiter for remote observations, and two classes of landed missions—the probe/capsule with battery power systems, and the larger lander/capsule which would probably contain nuclear power systems. In the Voyager concept, the spacecraft consists of three modules: a basic bus which is the octagonal ring to which the solar panels are attached; a retropropulsion system to place the bus into orbit; and a large landing capsule. A possible program evolution for Mars missions is discussed, and such problem areas as sterilization of the capsule, communications and data storage, nuclear power supplies, and retropropulsion are defined. The general areas of experimentation involved in the exploration of Mars are examined, and some of the possible experiments that the orbiter and capsule might carry are listed. M.G.J.

N66-31498*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

REVIEW OF MARINER 1962 AND 1964 SPACECRAFT DESIGN AND OPERATIONAL PLANNING

Dan Schneiderman *In* VPI Proc. of the Conf. on the Exploration of Mars and Venus Aug. 1965 16 p (See N66-31486 18-30) CFSTI: HC $7.00/MF $1.75

The spacecraft design, instrumentation, mission aims, and mission data are reviewed. The important engineering advances over Mariner II which were incorporated in Mariner IV are listed, and their weight comparisons are tabulated. Mariner III launch is mentioned, along with the associated problems. The Mariner IV launch sequence, trajectory, interplanetary maneuvers, and the anticipated difficulties are outlined. Communication with Mariner IV, correction signals to stop scan platform action, and photographic data recording are described. N.E.N.

N66-31499*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

SCIENCE PAYLOADS FROM MARINER II TO MARINER IV

Robert V. Meghreblian, Frank L. Schutz, and William G. Faucett *In* VPI Proc. of the Conf. on the Exploration of Mars and Venus Aug. 1965 14 p refs (See N66-31486 18-30) CFSTI: HC $7.00/MF $1.75

The design, development, and testing and operation of the spacecraft for the Mariner 1962 and Mariner 1964 projects are compared from the standpoint of their scientific payloads. The constraints imposed by the capabilities of the launch vehicles are pointed out in relation to the resulting spacecraft design. Because of these constraints, the spacecraft design preceded the science subsystem design so that an estimation of the total weight and power available for science instrumentation could be made. Charts which compare the status of the instrumentation for the two projects at the time of their selection and at launch, illustrate the flexibility that was required to integrate the science subsystems into the Mariner spacecrafts. H.S.W.

N66-31502*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

PROBE AND LANDER DESIGN PROBLEMS

Leonard Roberts *In* VPI Proc. of the Conf. on the Exploration of Mars and Venus Aug. 1965 10 p refs (See N66-31486 18-30) CFSTI: HC $7.00/MF $1.75

This paper is concerned with research and development problems that arise in the design of unmanned planetary probe and lander capsules, with emphasis on the latter in view of the imminent needs of the planetary program. Major elements comprising the overall spacecraft system are identified. The scientific and engeneering measurements to be made by the probe and lander capsules are discussed in relation to design considerations and technology requirements needed to solve the design problems. R.N.A.

N66-31504*# National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Ala.

MANNED PLANETARY RECONNAISSANCE MISSION STUDY: VENUS/MARS FLYBY

H. O. Ruppe *In* VPI Proc. of the Conf. on the Exploration of Mars and Venus Aug. 1965 44 p refs (See N66-31486 18-30) CFSTI: HC $7.00/MF $1.75

The feasibility of performing manned Mars and Venus flyby missions using available hardware is investigated. Emphasis is given to the conceptual design of a spacecraft with a high inherent reliability, the development of a reasonable mission profile, the identification of developments beyond the Apollo/Saturn V technology which are required, and the development of a reasonable time and cost schedule. The study also examines the justification for the manned flyby mission and describes the spacecraft, spacecraft design ground rules, and spacecraft systems. Orbital operations, mission integration, scientific payload, mission worth analysis, complete aerodynamic braking, nuclear injection from orbit, and problem areas are discussed. R.N.A.

N66-31584# Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.

TESTS ON A THERMALLY SCALED MODEL SPACE STATION IN A SIMULATED SOLAR ENVIRONMENT Final Report

N. R. Folkman Jun. 1966 78 p refs (SM-47916)

Tests on a thermally scaled model space station in a simulated solar environment are presented. Test objectives, scal-

ing criteria, model construction, testing facilities, testing procedures, and important data are discussed. In addition, analytic techniques and approaches to verification of results are outlined. A discussion of both experimental and analytical errors, conclusions derived from results, and recommendations for future tests are also presented. Author

N66-31813*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.

SPACECRAFT INTERFACE IN APOLLO, INCLUDING APOLLO EXPERIMENTAL PALLET

Raymond R. Clemence, Jr. *In* NASA, Washington Proc. of the Experimenters' Inform. Meeting on the Apollo Appl. Program in Biosci. 1966 p 75-91 (See N66-31806 18-04) CFSTI: HC $3.00/MF $1.00

The capability of the Apollo II command module to accommodate experiments is explored with regard to space allocation, available electrical power, type of cooling required, and possible linkup to a service module or an experimental pallet configuration. A pallet attached to the command module can accommodate as much as 3600 pounds of experiments, provide about 3600 watt hours of electric power for its own use, and can have a volume of about 170 feet. Also discussed are the steps necessary for an experiment to go through after formulation of the work statement up to the delivery of the hardware and the successful completion of qualification testing before implementation. G.G.

N66-31816*# AVCO Corp., Lowell, Mass. Space Systems Div.

COMPARATIVE STUDIES OF CONCEPTUAL DESIGN AND QUALIFICATION PROCEDURES FOR A MARS PROBE/LANDER. VOLUME I: SUMMARY Final Report

11 May 1966 203 p refs

(Contract NAS1-5224)

(NASA-CR-66128; AVSSD-0006-66-RR, Vol. I) CFSTI: HC $3.75/MF $1.25 CSCL 22B

The Mars probe/lander entry from the approach trajectory mission mode is compared with the entry from the orbit mission mode, and the systems and subsystems designs which evolved from these concepts are summarized. As data obtained from Mariner IV indicated that the Martian atmosphere is in the 5 to 10 millibar range, the study objectives and guidelines were modified, with emphasis focused on the entry from orbit concept. The important characteristics of the conceptual capsule design are listed, and the required development test programs for the six capsule subsystems indicates that the parachute is the single feasibility problem in the capsule design. The development of a sterilization technology is discussed, particularly the use of the burden analysis technique which provides a quantitative basis for the sterilization problem and enables the comparative evaluation of various handling and decontamination methods. Results show that parts can be manufactured under normal industry conditions, and that components can be assembled using essentially standard procedures. It was concluded that a practical means of biological burden control is possible without severe economic penalty. M.G.J.

N66-31817*# AVCO Corp., Lowell, Mass. Space Systems Div.

COMPARATIVE STUDIES OF CONCEPTUAL DESIGN AND QUALIFICATION PROCEDURES FOR A MARS PROBE/LANDER. VOLUME II: PROBE/LANDER, ENTRY FROM THE APPROACH TRAJECTORY. BOOK 1: SYSTEM DESIGN Final Report

11 May 1966 327 p refs

(Contract NAS1-5224)

(NASA-CR-66129; AVSSD-0006-66-RR, V. II, Bk-1) CFSTI: HC $4.25/MF $1.75 CSCL 22B

System and subsystem designs and operation for the Mars probe landing capsule are summarized for entry from the approach trajectory system, which was based on estimated surface pressures of 10 to 40 millibars. The mission concept discussed involves separation of the flight capsule from the flight spacecraft on the approach trajectory a few million kilometers from Mars. Mission objectives, contraints, and study ground rules are reviewed. System characteristics, operational sequence, and weight and balance are described. Characteristics are detailed for the subsystems, which include command and programming, instrumentation, telecommunication, power, propulsion, attitude control, parachute, impact attenuation, entry shell, and thermal control. Entry shell selection and tradeoffs for the landed capsule and the attitude control system are discussed. Failure mode and launch period analyses are included. E.A.O.

N66-31818*# AVCO Corp., Lowell, Mass. Space System Div.

COMPARATIVE STUDIES OF CONCEPTUAL DESIGN AND QUALIFICATION PROCEDURES FOR A MARS PROBE/LANDER. VOLUME II: PROBE/LANDER, ENTRY FROM THE APPROACH TRAJECTORY. BOOK 2: MISSION AND SYSTEM SPECIFICATIONS Final Report

T. R. Ellis et al 11 May 1966 153 p

(Contract NAS1-5224)

(NASA-CR-66130; AVSSD-0006-66-RR, V. II, Bk-2) CFSTI: HC $3.25/MF $1.00 CSCL 22B

System specifications for a Mars mission based upon entry of a capsule from the interplanetary approach trajectory is presented. The capsule system ground rules, guide lines, and definitions of the general design philosophy, including listing of design criteria for the flight capsule and operational support equipment for a 1971 Mars mission is provided. Primary functional areas are identified and described. The flight capsule mission objectives are defined relative to the overall Mars exploratory mission, including a nominal flight profile. Major constraints, mission performance, and design requirements placed on the capsule system by the mission are also considered. It is pointed that the data are incomplete as study efforts were terminated before a conceptual design was selected. A.G.O.

N66-31819*# AVCO Corp., Lowell, Mass. Space Systems Div.

COMPARATIVE STUDIES OF CONCEPTUAL DESIGN AND QUALIFICATION PROCEDURES FOR A MARS PROBE/LANDER. VOLUME III: PROBE, ENTRY FROM ORBIT. BOOK 1: SYSTEM DESIGN Final Report

T. R. Ellis et al 11 May 1966 302 p

(Contract NAS1-5224)

(NASA-CR-66131; AVSSD-0006-66-RR, V. III, Bk-1) CFSTI: HC $4.25/MF $1.75 CSCL 22B

The system design of a nonsurvivable probe to perform engineering experiments for the determination of Mars atmospheric and terrain properties is presented. The flight capsule is to be deployed from the flight spacecraft while in Mars orbit to allow use of shallow entry angles required by model atmospheres which vary from 5- to 10- millibars surface pressures. The study includes all necessary parametric and systems analyses leading to a conceptual design, with particular emphasis on critical tradeoff regions and the necessary assumptions and decisions which have led to the conceptual design. Experiment designs for television, surface hardness penetrometers, and wind measurement instrumentation which is included in the science payload are discussed. Mission constraints, subsystem characteristics, entry vehicle design, de-

orbit techniques, attitude control system tradeoffs, and capsule telecommunications are also reported. A.O.

N66-31820*# AVCO Corp., Lowell, Mass. Space Systems Div.
COMPARATIVE STUDIES OF CONCEPTUAL DESIGN AND QUALIFICATION PROCEDURES FOR A MARS PROBE/LANDER. VOLUME III: PROBE ENTRY FROM ORBIT. BOOK 2: MISSION SYSTEM AND SUBSYSTEM SPECIFICATIONS Final Report
T. R. Ellis et al 11 May 1966 203 p
(Contract NAS1-5224)
(NASA-CR-66132; AVSSD-0006-66-RR, V. III, Bk-2) CFSTI: HC $4.25/MF $1.75 CSCL 22B

The capsule system general ground rules, guide lines, and definitions of the general design philosophy, including the design criteria for the flight capsule and operational support equipment, for a 1971 Mars probe are presented. The capsule is to be deployed into the Mars atmosphere after separation from a planetary vehicle which has attained an orbit around Mars for a predetermined time. Detailed requirements data were formulated for each subsystem and operational application of these requirements resulted in related subsystem design. Component specifications are given for subsystem areas requiring technical definition. In some cases the design solution presented is one of several which could accomplish the intended function of the subsystem. Mission objectives and constraints also are defined in relation to the overall Mars exploration mission, including a nominal flight profile. A.O.

N66-31821*# AVCO Corp., Lowell, Mass. Space Systems Div.
COMPARATIVE STUDIES OF CONCEPTUAL DESIGN AND QUALIFICATION PROCEDURES FOR A MARS PROBE/LANDER. VOLUME III: PROBE, ENTRY FROM ORBIT. BOOK 3: DEVELOPMENT TEST PROGRAMS Final Report
William P. Neacy et al 11 May 1966 235 p refs
(Contract NAS1-5224)
(NASA-CR-66133; AVSSD-0006-66-RR, V. III, Bk. 3) CFSTI: HC $3.75/MF $1.25 CSCL 22B

Subsystem development status and critical ground development tests for the Mars probe, with entry from orbit design are discussed. Details are given on ground testing requirements of the entry vehicle shell, sterilization canister, separation, parachute, propulsion, and attitude control subsystems, and recommended flight tests are given for parachute, separation systems, and heat shield performance. A preliminary program plan for a 1971 probe/lander mission, based on a direct entry concept, is also included. L.E.W.

N66-31822*# AVCO Corp., Lowell, Mass. Space Systems Div.
COMPARATIVE STUDIES OF CONCEPTUAL DESIGN AND QUALIFICATION PROCEDURES FOR A MARS PROBE/LANDER. VOLUME IV: STERILIZATION Final Report
Walter J. Schafer et al 11 May 1966 224 p refs
(Contract NAS1-5224)
(NASA-CR-66134; AVSSD-0006-66-RR, Vol. IV) CFSTI: HC $3.75/MF $1.25 CSCL 22B

Details are given on the sterilization investigations conducted as a part of the study of conceptual designs and qualification procedures for a Mars probe, with emphasis on definition of a plan for an integrated sterilization control and management program. The basic considerations in defining such a program are outlined, including design, manufacturing and assembly factors. Techniques of performing biological burden estimates are presented, and the sources of contamination and decontamination and estimates of the burden at various stages of assembly of the probe are discussed. The problems involved in burden monitoring, and the type and number of assays required are considered. Sterilization control problems during and after terminal sterilization, techniques of heat application, and verification of kill effectiveness are outlined, and implications for training personnel are reviewed. Outlines are given of sterilization and implementation plans for probes designed for entries from orbit and from approach trajectory. Details are also given on effects of the sterilization process on materials and components. L.E.W.

N66-31824*# AVCO Corp., Lowell, Mass. Space Systems Div.
COMPARATIVE STUDIES OF CONCEPTUAL DESIGN AND QUALIFICATION PROCEDURES FOR A MARS PROBE/LANDER. VOLUME V: SUBSYSTEM AND TECHNICAL ANALYSES. BOOK 2: AEROMECHANICS AND THERMAL CONTROL Final Report
R. M. Davis et al 11 May 1966 868 p refs
(Contract NAS1-5224)
(NASA-CR-66136; AVSSD-0006-66-RR, Vol. V, Bk-2) CFSTI: HC $10.18/MF $4.00 CSCL 22B

Aerodynamics, thermodynamics, structural mechanics, and thermal control studies are described which led to the definition of the entry shell environments, conceptual designs, and performance characteristics. To select conceptual designs of probe/lander direct entry from approach trajectory and to determine critical design conditions, a broad parametric study was conducted of aerodynamic structural, and thermal protection configurations, for several mission concepts, atmospheres, aerodynamic shapes, and for various system requirements. from orbit, a study was made of a 60-degree blunted cone entry shell utilizing practical structural aid thermal configurations for several orbital trajectories and flight envelope parameters to determine the critical design conditions in terms of the atmospheres and failure modes. The entry shell and thermal control preliminary designs were established and their performance was evaluated for the probe entry from orbit. E.A.O.

N66-31846*# AVCO Corp., Lowell, Mass. Space Systems Div.
COMPARATIVE STUDIES OF CONCEPTUAL DESIGN AND QUALIFICATION PROCEDURES FOR A MARS PROBE/LANDER. VOLUME V: SUBSYSTEM AND TECHNICAL ANALYSES. BOOK 4: INSTRUMENTATION Final Report
11 May 1966 477 p refs
(Contract NAS1-5224)
(NASA-CR-66138; AVSSD-0006-66-RR, Vol. V, Bk-4) CFSTI: HC $5.27/MF $2.25 CSCL 22B

The instrumentation portion of the Mars probe study encompassed the selection of the payload for the 1971 flight capsule, the analysis of the interfaces between this payload and the other flight capsule subsystems, and the integration of the selected payload with the remainder of the flight capsule. For the 1971 mission, two cases were considered; the entry from approach trajectory case, and the entry from orbit case. In defining the payloads, the overall mission objectives were studied and a list of candidate experiments was assembled and evaluated to determine their suitability for the various missions. Among the experiments considered were; the television, penetrometer, acoustic densitometer, gas chromatograph, beta scatter and water detector experiments. Details are given on the experiment objectives, major system and performance tradeoffs, the selected design, and the problem areas expected. H.S.W.

N66-31847*# AVCO Corp., Lowell, Mass. Space Systems Div.
COMPARATIVE STUDIES OF CONCEPTUAL DESIGN AND QUALIFICATION PROCEDURES FOR A MARS PROBE/LANDER. VOLUME V: SUBSYSTEM AND TECHNICAL ANALYSES. BOOK 5: ATTITUDE CONTROL AND PROPULSION Final Report
11 May 1966 252 p
(Contract NAS1-5224)
(NASA-CR-66139; AVSSD-0006-66-RR, Vol. V, Bk-5) CFSTI: HC $3.75/MF $1.50 CSCL 22B

The attitude control and propulsion requirements for the Mars Probe/Lander are discussed. Attitude control for entry from the approach trajectory, and for entry from orbit are treated separately, and the propulsion system for both missions is covered. Entry from the approach trajectory requires precise control of the direction of the applied capsule incremental velocity, while entry from orbit places less stringent requirements on the attitude control system. A closed-loop cold-gas attitude control system was chosen for both missions. An inertial platform is used for attitude reference for the entry from orbit mission, and for attitude control while thrusting during the deorbit maneuver, a hot-gas reaction control system is used. Both missions make use of a solid propellant rocket motor, using an existing sterilizable propellant. For entry from the approach trajectory the Titan vernier rocket was chosen; for entry from orbit, a design similar to the Surveyor main retromotor was selected. H.S.W.

N66-31848*# AVCO Corp., Lowell, Mass. Space Systems Div.
COMPARATIVE STUDIES OF CONCEPTUAL DESIGN AND QUALIFICATION PROCEDURES FOR A MARS PROBE/LANDER. VOLUME V: SUBSYSTEM AND TECHNICAL ANALYSES. BOOK 6: MECHANICAL SUBSYSTEMS Final Report
11 May 1966 286 p refs
(Contract NAS1-5224)
(NASA-CR-66140; AVSSD-0006-66-RR, Vol. V, Bk-6) CFSTI: HC $3.75/MF $1.50 CSCL 22B

The mechanical subsystems that are incorporated in the flight capsule designs for the entry from approach trajectory and entry from orbit studies are discussed. The mechanical subsystems include the separation, the parachute, impact attenuation, and the sterilization canister pressurization subsystems. Each of the subsystem analyses are discussed in terms of both studies, and summary results of the design concepts for each study are included. Expected problem areas are noted and recommendations for further study in these areas are made. H.S.W.

N66-31849*# National Aeronautics and Space Administration, Washington, D. C.
SECOND UNMANNED APOLLO MISSION, A UNIQUE STUDY
26 Jun. 1966 38 p
(NASA News Release-66-157) Available from the Scientific and Technical Information Division CSCL 22B

A narrative account is given of the second Saturn/Apollo Uprated Saturn I launch development mission. The expected flight sequence is outlined and the experiments to be performed are cited. One of the most important studies during the mission is the behavior of the liquid hydrogen fuel during orbital flight. Informative background material is provided on experiment control, the Saturn I launch vehicle, prelaunch checkout and countdown, launch complex 37, the mission objectives, the subcritical cryogenic experiment, and instrumentation and data acquisition. H.S.W.

N66-31867*# Honeywell, Inc., St. Paul, Minn.
MINIMAX CONTROL OF LARGE LAUNCH BOOSTERS
K. D. Graham Washington, NASA, Jul. 1966 77 p
(Contract NAS8-11206)
(NASA-CR-546) CFSTI: HC $3.00/MF $0.75 CSCL 22D

Optimal control theory has been applied to a piecewise constant approximation of a large launch booster for the first 84 seconds of flight. This period was divided into seven intervals with a different constant approximation of the vehicle in each interval. The controllers considered are linear controllers with constant gains in each flight interval. The disturbances are the crosswinds of bounded amplitude which cause the maximum of any of several cost items to occur in each flight interval, and each cost item is proportional to some physical quantity of interest. The cost of a given controller is the maximum of its several cost items. Bending moment is weighted heavily in the cost items for the minimax computations. A comparison of control costs for specific drift-minimum controllers and minimax controllers is presented. It is found that the minimax controllers have lower gains and substantially lower costs than the specific drift minimum controllers considered. Author

N66-31888*# Consultants and Designers, Inc., Arlington, Va.
FLIGHT OF THE INTERPLANETARY AUTOMATIC STATIONS "VENUS-2" AND "VENUS-3" [O POLETE AVTOMATICHESKIKH MEZHPLANETNYKH STANTSIY "VENERA-2" I "VENERA-3"
14 Mar. 1966 20 p Transl. into ENGLISH from Pravda (Moscow) no. 65, 6 Mar. 1966
(Contract NAS5-9299)
(NASA-CR-76460; ST-PR-LPS-10457) CFSTI: HC $1.00/MF $0.50 CSCL 22A

Two methods of investigating the planet Venus are described: (a) the Venus-2 probe in a flyby mission to effect measurements, and take photographs; (b) the Venus-3 probe of the planet's atmosphere to transmit direct measurements of surface termperature and pressure. The scientific flight problems included investigation of interplanetary space between Earth's and Venus' orbits, and investigation of Venus' surface. Technical equipment of the probes is briefly described for the following systems: guidance, command, radiocommunication, orientation and correction, and a parachute system for surface landing. Motion and flight trajectory corrections are reported, and measurements made are considered of independent scientific value. R.L.I.

N66-31891*# Consultants and Designers, Inc., Arlington, Va.
SOVIET PRESS COMMUNIQUES AND THE PRAVDA EDITORIAL ON "LUNAR-9" SOFT LANDING ON THE MOON
10 Feb. 1966 21 p Transl. into ENGLISH from Pravda and Komsomol'skaya Pravda (Moscow), 4–5 Feb. 1966
(Contract NAS5-3760)
(NASA-CR-76466; ST-PR-10445) CFSTI: HC $1.00/MF $0.50 CSCL 22B

The Luna-9 soft landing on the moon is reported; details are given on radio transmission sessions, and the telemetry system. Some recorded photographs showing geographic details of the lunar surface are included. The lunar station itself, its engine system, and instrument compartments are listed. The schematized flight depicts: carrier rocket placing the probe in orbit, the rocket block firing for acceleration into the lunar flight trajectory, and subsequent trajectory correction. Parameters of the orbit are briefly outlined, and the exact marine landing site is indicated. R.L.I.

N66-31901*# Consultants and Designers, Inc., Arlington, Va.
LUNA-10 IN ORBIT AROUND THE MOON. ONE STEP FURTHER INTO SPACE [LUNA-10 NA ORBITE VOKRUG LUNY. YESHCHE ODIN SHAG V KOSMOS]
11 Apr. 1966 13 p Transl. into ENGLISH from Tass Communique and Pravda (Moscow), no. 95, 5 Apr. 1966
(Contract NAS5-9299)
(NASA-CR-76479; ST-PR-LPS-10472) CFSTI: HC $1.00/MF $0.50 CSCL 22B

This report consists in the official Tass communique on the achievement by LUNA-10 of orbit around the moon, and the PRAVDA editorial of the same date, providing details relative to the way the lunar orbiting was achieved, and giving the various flight parameters. The column ends with general comments on the performance. It is illustrated by sketches and a later view of the automatic station. Author

N66-31934*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SATELLITE SITUATION REPORT, VOLUME 6, NUMBER 10
31 May 1966 28 p
(NASA-TM-X-57745; X-512-66-51) CFSTI: HC $2.00/MF $0.50 CSCL 22B

Data computed and compiled by the Goddard Space Flight Center, NORAD, and the Smithsonian Astrophysical Observatory as of 1200Z on May 31, 1966 on objects in orbit and decayed objects are given in tabular form. Information on the objects, listed by time of launch, include code name, catalogue number, source, launch date, period in minutes, inclination, apogee and perigee in kilometers, and transmitting frequency in megacycles per second. L.E.W.

N66-32044*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
PUBLICATIONS OF GODDARD SPACE FLIGHT CENTER, 1963. VOLUME II: SPACE TECHNOLOGY
[1963] 1084 p refs
(NASA-TM-X-57738) CFSTI: HC $7.00/MF $5.00 CSCL 22B

Articles on spacecraft and subsystems, vehicle technology, sounding rockets, sensors, environmental testing, and tracking systems are presented. For individual titles see N66-32045–N66-32081.

N66-32045*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
STEREO PHOTOGRAPHY OF THE ECHO II BALLOONS NUMBER 9, 11, AND 13
Sol H. Genatt *In its* Publ. of Goddard Space Flight Center, 1963, Vol. II [1963] p 22–31 (See N66-32044 18-31) CFSTI: HC $7.00/MF $5.00

A description is given of the equipment and technique used to determine the deviation from sphericity of the skin of three Echo II balloon satellites at varying skin pressures. Diagrams and photographs illustrate the instrumental setup and the results of the stereophotography. Author

N66-32046*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
RELAY
Robert H. Pickard and Sidney Metzger (Commun. Satellite Corp.) *In its* Publ. of Goddard Space Flight Center, 1963, Vol. II [1963] p 105–110 (See N66-32044 18-31) CFSTI: HC $7.00/MF $5.00

The communications satellite Relay I subsystems are described and their performances during 499 operations are evaluated. This orbiting spacecraft provided an experimental microwave repeater for transmission of TV signal or 600 voice channels that can also be utilized for high speed data, facsimile, or teletype traffic with bandwidths of up to 4 Mc. System demonstration experiments, emphasizing quality television and telephony, established good multiburst signals, EIA test patterns, bar and window patterns, and good quality pictures; results on two way multiple channel phone calls between the United States and Europe indicated severe echo problems that make echo suppression techniques mandatory. Spacecraft tracking with narrow beamwidth antennas provided accurate prediction data for programmed steering. It was concluded that satellite born microwave repeaters can provide high quality wideband communication service in a stable predictable manner. G.G.

N66-32047*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
RELAY I SPACECRAFT PERFORMANCE
Robert H. Pickard *In its* Publ. of Goddard Space Flight Center, 1963, Vol. II [1963] p 111–121 (See N66-32044 18-31) CFSTI: HC $7.00/MF $5.00

This paper describes RELAY I, an experimental communications spacecraft. Factors leading to the design of an experimental communications satellite are considered. Limitations in the bandwidth of available klystrons for ground transmitters required the use of modulation index tripling in the spacecraft to obtain usable signal to noise ratios on the spacecraft to ground path. Simultaneous two-way telephone experiments required that two separate IF channels be provided to prevent signal suppression and to reduce cross modulation products. It was necessary to provide 20 command channels and 128 multiplexed PCM telemetry channels to operate the spacecraft and evaluate its performance. Prelaunch performance evaluation of the communications equipment consisted of measuring parameters such as S/N ratio, group delay, noise loading, bandwidth, cross talk, frequency, and power output. A summary of experimental results obtained from in-orbit operations indicates close correlation to prelaunch measurements. Illustrations of experimental results are given. Author

N66-32048*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
RELAY, AN EXPERIMENTAL SATELLITE FOR TV AND MULTICHANNEL TELEPHONY COMMUNICATIONS
Robert H. Pickard, S. Roth, and J. Kiesling *In its* Publ. of Goddard Space Flight Center, 1963, Vol. II [1963] p 122–140 (See N66-32044 18-31) CFSTI: HC $7.00/MF $5.00

Design details of the Relay communications repeater satellite and its mission objectives are outlined. The primary function of the Relay satellite is to investigate the technological problems of wideband transmission and to develop operational experience for satellite communications systems. The spacecraft weighs 170 pounds and will be launched by a Delta vehicle; its power supply consists of a solar cell array and hermetically sealed nickel cadmium storage batteries. The communication system used in the Relay spacecraft is composed of the following three major subsystems: (1) wideband communications; (2) telemetry; and (3) command control. Its main components are a slotted antenna array for telemetry and command mounted on top of the spacecraft, a solid receiver with varacter multipliers and IF branching, and a traveling wave tube amplifier designed to operate in the vacuum environment of outer space. Performance data for some typical links are shown in a table, and some future radiation detection experiments are briefly discussed. G.G.

N66-32049*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

TIROS ACHIEVEMENTS

Robert M. Rados *In its* Publ. of Goddard Space Flight Center, 1963. Vol. II [1963] p 146–148 refs (See N66-32044 18 31) CFSTI: HC $7.00/MF $5.00

A brief review on the Tiros satellite's special accomplishments in providing and using cloud photography is presented together with performance data from 6 spacecraft launchings. Obtained cloud pictures proved the feasibility of meteorological satellites for detecting hurricanes and typhoons, and their use in ice reconnaissance for antarctic supply tasks. G.G.

N66-32050*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

SATELLITE ATTITUDE DETERMINATION: DIGITAL SENSING AND ON-BOARD PROCESSING

J. S. Albus and D. H. Schaefer *In its* Publ. of Goddard Space Flight Center, 1963. Vol. II [1963] p 221–229 refs (See N66-32044 18-31) CFSTI: HC $7.00/MF $5.00

The determination of the aspect or orientation of spin stabilized satellites is vital for the correct interpretation of scientific measurements made on these spacecraft. Aspect information is collected optically from the sun, moon and earth. Little channel capacity is generally available for telemetry of this information. Therefore, completely digital low power aspect sensing and on-board information processing systems have been built and flown on various satellites. Some interesting results of aspect measurements on Explorer XII showed an unexpected increase in spin rate due to solar pressure, and on Explorer XIV an erratic precession history. Author

N66-32051*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

FINE POINTING CONTROL FOR THE ORBITING ASTRONOMICAL OBSERVATORY (OAO)

Gordon E. Graham *In its* Publ. of Goddard Space Flight Center, 1963. Vol. II [1963] p 294–298 refs (See N66-32044 18-31) CFSTI: HC $7.00/MF $5.00

High pointing accuracy requirements are imposed on the control system of the OAO. One tenth arcsec angular accuracy can be achieved in orbiting spacecraft using star references, long focal length optical systems, and relatively small torquing devices. Noise problems are introduced when a single error sensor is required to track stars with greatly different magnitudes. As star magnitude decreases, the compensating increase in the gain by the automatic gain control decreases the signal-to-noise ratio and degrades the pointing accuracy. A linear range of at least one arcmin will eliminate or reduce many restrictions on initial acquisition of a particular star. These restrictions are introduced by high initial satellite rates and/or unbalanced inertial wheel torques. Relatively small voltage rates out of the sensor may be detected by a suitably designed nonlinear lead circuit with low frequency corners. Author

N66-32055*# General Mills, Inc., Minneapolis, Minn. Electronics Div.

CHARACTERISTICS OF PASSIVE COMMUNICATION SATELLITES WITH LAMBERTIAN SURFACES

Herbert P. Raabe *In* NASA. Goddard Space Flight Center Publ. of Goddard Space Flight Center, 1963. Vol. II [1963] p 346–356 refs Presented at the 13th Intern. Astron. Congr., Varna, Bulg., 28 Sep. 1962 (See N66-32044 18-31) CFSTI: HC $7.00/MF $5.00

(Contracts NAS5-890; NAS5-1598)

Passive Communication Satellites with surfaces reflecting diffusely according to Lambert's law are particularly attractive since they afford a directional pattern well matched to the optimum pattern of satellites in lower orbits and since such surfaces are easily realized. The echo from diffuse reflectors varies statistically, and a combination diversity technique of frequency should be used to stabilize the signal. A spherical satellite is no longer required; and weight reduction and higher reliability can be gained from polyhedral structures. Compared with a rigidized specularly reflecting sphere, a Lambertian reflector affords a 7 db stronger echo for the same weight. Model tests of reflectivity agree well with the theory. Author

N66-32067*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

THE SOUTHERN SKY SURVEY PAYLOAD

Richard M. Windsor *In its* Publ. of Goddard Space Flight Center, 1963. Vol. II [1963] p 626–635 refs (See N66-32044 18-31) CFSTI: HC $7.00/MF $5.00

Four Skylark rockets were fired from Woomera Missile Range, Australia, to measure stellar fluxes and nebulosities at energy bands between 1050 and 2800A. The payloads contained two basic types of detector systems: photomultipliers for the spectral region between 1900 and 2800A, and ionization chambers for the 1050 to 1500A range. Data acquisition was optimized by a spin control gas jet system. Also described are the vehicle, field operations, and performance. Author

N66-32068*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

THE PURPOSE OF ENVIRONMENTAL TESTING FOR SCIENTIFIC SATELLITES

John H. Boeckel *In its* Publ. of Goddard Space Flight Center, 1963. Vol. II [1963] p 646–657 refs (See N66-32044 18-31) CFSTI: HC $7.00/MF $5.00

The economic necessity of high reliability dictates a major role for environmental testing in the exploration of space. High reliability in spacecraft can be achieved only through extensive environmental testing. Successful testing depends on a comprehensive test plan that is formulated from the requirements of specific programs. Successful satellites and space probes can be achieved most economically by full use of such test programs and by the timely application of object lessons learned from previous programs. Author

N66-32082*# National Aeronautics and Space Administration, Washington, D. C.

GEOPHYSICAL OBSERVATORY LAUNCH MAY 31

29 May 1966 44 p

(NASA News Release-66-132) Available from the Scientific and Technical Information Division CSCL 22B

Scientific objectives, design details, and the launch sequence for the OGO-B geophysical satellite are discussed by the National Aeronautics and Space Administration. This orbiting laboratory will be launched after May 31, 1966, and will carry a number of experiments designed to obtain information on the relationship between our Sun and the nature of the Earth's environment. Scientific objectives of the OGO-B mission are: (1) to investigate trapped radiation with magnetic activity; (2) to observe particle and electro-magnetic fluctuations; (3) to measure the interplanetary solar plasma and magnetic field; (4) to study galactic and solar cosmic rays; (5) to analyze the charged portion of the atmospheric composition; (6) to find correlations between ion distribution, magnetic fields, and electron density; (7) to measure

various low frequency noise phenomena; and (8) to study the geocorona, gegenschein, and micrometeoroid distributions. G.G.

N66-32083*# National Aeronautics and Space Administration, Washington, D. C.

PAGEOS SATELLITE TO GIRDLE GLOBE FOR EARTH MAPPING

19 Jun. 1966 28 p

(NASA News Release-66-150) Available from the Scientific and Technical Information Division CSCL 22B

The National Aeronautics and Space Administration presents a brief outline of the design, fabrication, launch window, and observational network for the inflatable Pageos satellite. This 100 ft balloon will be launched after June 23, 1966 by a Thor–Agena-D launch vehicle into a circular polar orbit about 2600 miles above Earth. Its aluminum coating will provide an orbiting point source of light to be photographed by a network of 41 ground observing sites around the earth. Photographs will be taken in dark areas of the world as the satellite's reflection from the Sun is visible for several minutes. The resulting network of spatially-oriented triangles will then be used for precision mapping of the earth's surface. G.G.

N66-32140*# Lockheed Missiles and Space Co., Sunnyvale, Calif.

THE AEROELASTIC CHARACTERISTICS OF THE SATURN IB SA-203 LAUNCH VEHICLE

Lars Eric Ericsson and Norman J. French Apr. 1966 120 p refs

(Contract NAS8-11238)

(NASA-CR-76563; M-37-66-2) CFSTI: HC $3.00/MF $0.75 CSCL 22D

The aeroelastic properties, and the effects of boundary layer-terminal shock wave interaction on the Saturn IB SA-203 launch vehicle are described; the aerodynamic damping characteristics, and the flow field over the forward portion of the vehicle are presented. The results of the static aerodynamic data analysis were used in the quasi-steady computational method to predict the aerodynamic damping in the Mach number range of 0.7 to 2.0. Computed results show that the SA-203 vehicle is aeroelastically stable for the first three bending modes; it is therefore speculated that the vehicle will be aerodynamically damped over the entire ascent trajectory. The generalized payload, i.e., the 25° –12.5° double cone effectively eliminated the dangerous sudden separation and reduced the accelerated flow effect. R.LI.

N66-32144*# TRW Systems, Redondo Beach, Calif.

THE PIONEER SPACECRAFT

A. B. Mickelwait [1966] 32 p refs Presented at the Symp. on Exploration of the Moon and Interplanetary Space, Munich, 22 Apr. 1966

(Contract NAS2-1700)

(NASA-CR-76541) CFSTI: HC $2.00/MF $0.50 CSCL 22D

Described are the design history, configuration, and scientific experiments of the Pioneer VI spacecraft; the technical instrument payload, and performance characteristics of the interplanetary flight and solar probe are reported. Instrumentation was carried for: six experiments for measuring electrons, protons, and alpha particles at various energies in the spacecraft vicinity, two cosmic ray experiments, a radio propagation experiment, and two plasma probes to measure the flux, incident angle, and energy spectrum of the solar plasma. Components of the following spacecraft systems are mentioned: communications, data handling, power, and orientation. Flight trajectory details are summarized on the escape trajectory, heliocentric orbital elements, inclination, axial rotation, and certain other orientational maneuvers. Schematics complement the description of instrumentation and trajectory. R. LI.

N66-32167*# National Aeronautics and Space Administration, Washington, D. C.

SURVEYOR A

26 May 1966 57 p

(NASA News Release-66-127) CSCL 22B

This report describes various design and mission aspects of the Surveyor A spacecraft, the first in a series of Surveyor spacecraft designed to achieve a soft landing on the moon and to gather lunar surface information needed for the Apollo manned lunar landing program. The Surveyor spacecraft and its subsystems are described along with the Atlas–Centaur launch vehicle, its preflight checkout, and the Centaur flight history. Pertinent launch vehicle data and flight sequence data are tabulated. The Surveyor flight profile and lunar trajectories are depicted. Tracking and communication by the Deep Space Network and the Space Flight Operations Facility, the earth–moon trajectory, and the sequence of events from lift-off to post-landing activities are described in detail. Characteristic Atlas Centaur lunar injection parameters are also depicted. R.N.A.

N66-32191*# National Aeronautics and Space Administration, Washington, D. C.

GEMINI 10

9 Jul. 1966 74 p

(NASA News Release-66-179) Available from the Scientific and Technical Information Division CSCL 22B

General information on the Gemini 10 launch, and background information on the crew training and the provisions are presented in a NASA press kit release. Described are the preflight activities and integrated countdown; the mission itself (launch, rendezvous, retrofire, etc.); various scientific, medical, and technological experiments to be performed; the manned space flight tracking network; the abort and recovery; the Gemini spacecraft; the Gemini launch vehicle; the Agena target vehicle; and the Atlas launch vehicle. Short biographies of the crew, and a list of spacecraft contractors are given. A chronological table listing the approximate times of major events to be performed during the flight is also presented. L.S.

N66-32267*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.

RELATIVE ADVANTAGES OF SMALL AND OBSERVATORY TYPE SATELLITES

G. H. Ludwig *In its* Goddard Space Flight Center Contrib. to the COSPAR Meeting, May 1965 Jul. 1966 p 1–11 (See N66-32266 18-30) CFSTI: HC $7.00/MF $1.50

Both the relatively small Explorer and the large Orbiting Observatory classes of scientific satellites have advantages which need to be considered carefully when a new space experiment is to be performed. The small satellite offers greater choice in tailoring the orbit to the experiments, and simplifies the electrical, magnetic, and radiated interference problem, since fewer operating components are involved. It also provides greater ease in testing and scheduling, and permits a shorter pre-launch lead time. The larger observatory permits the conduct of more complex or larger numbers of related experiments for the more detailed study of the co-relationships between the numerous space phenomena. Since it is less highly integrated, standard experiment/spacecraft interfaces can be defined to simplify the experiment design and integration problems. The larger size permits the use of

high capacity and more flexible data systems and more precise active orientation systems. Operational efficiency is higher, since the data from a large number of experiments can be recorded and processed simultaneously. Author

N66-32268*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE NIMBUS I METEOROLOGICAL SATELLITE-GEOPHYSICAL OBSERVATIONS FROM A NEW PERSPECTIVE
N. Nordberg *In its* Goddard Space Flight Center Contrib. to the COSPAR Meeting, May 1965 Jul. 1966 p 13–33 refs (See N66-32266 18-30) CFSTI: HC $7.00/MF $1.50

The Nimbus I meteorological satellite which was launched into a nearly polar sunsynchronous orbit and was fully earth oriented carried a set of very high resolution television cameras, a directly transmitting television camera of lesser resolution and a high resolution infrared radiometer. The observations of detailed cloud features during daytime, the direct transmission of such observations to local weather station via an automatic picture transmission system and the measurement and pictorial presentation of earth, water and cloud temperatures from orbital altitudes at nighttime with the infrared radiometer have provided geophysical and meteorological measurements from a truly global perspective. Temperatures of ice surfaces of Antarctica and Greenland were presented in high resolution radiation pictures with accuracies of about ±2°K. Pictorial maps of cloud cover and of cloud top heights were obtained during nighttime permitting a three-dimensional analysis of the global cloud structure and inferences regarding the dynamics of weather fronts, severe storms and atmospheric circulation cells. Measurements of sea surface temperatures were made in many areas of the world. Author

N66-32301*# Smithsonian Astrophysical Observatory, Cambridge, Mass.
THE DECAY OF SATELLITE 1965-79A
William P. Hirst 10 Jun. 1966 47 p ref
(Grant NsG-563)
(NASA-CR-76688; SAO Special Rept.-214) CFSTI: HC $2.00/MF $0.50 CSCL 22B

The decay of Satellite 1965-79A took place on 1965 October 29 and was observed across Europe. The observers' descriptions of the decay are quoted and position measures are tabulated. The object was already self-luminous when first seen at a height computed as 92.6 km; a luminous trail began to form at a height of 9[illegible] km, [illegible] fragments were first seen breaking away at a height of about 82 km. The decay trajectory as indicated by the measures is investigated with the help of an ephemeris supplied by NORAD. It is concluded that the observations fix the height with an uncertainty probably not greater than 0.5 km. A rough indication of the probable impact point is given. Author

N66-32533*# National Aeronautics and Space Administration, Washington, D. C.
MOON ORBITING EXPLORER SCHEDULED FOR JUNE 30 LAUNCH
27 Jun. 1966 25 p
(NASA News Release-66-162) Available from the Scientific and Technical Information Division CSCL 22B

A project outline for the moon-orbiting Explorer D, an Anchored Interplanetary Monitoring Platform, is given. Characteristics of the spacecraft and its equipment are briefly described. Launch vehicle, launch data, trajectory, and lunar orbit are discussed. The two magnetometers for studying interplanetary magnetic fields and the magnetic tail and magnetosphere of the earth are described. Three radiation experiments aboard the spacecraft are listed: an energetic particle experiment, an electron and proton experiment, and a thermal ion and electron experiment. Some details are also given on a solar wind experiment, a solar cell damage experiment, and on a study of selenodesy and propagation of lunar ionosphere radio waves. Statistical data on the Delta launch rocket are also included. K.W.

N66-32631*# National Aeronautics and Space Administration, Washington, D. C.
NASA SCHEDULES SECOND IN NEW PIONEER SERIES
11 Aug. 1966 43 p
(NASA News Release-66-311) Available from the Scientific and Technical Information Division CSCL 22B

A narrative account is given of the mission of, and the data expected from Pioneer B spacecraft. As a guide to the information expected from this mission, the discoveries made by Pioneer VI are discussed including: the non-straight line flow of the solar wind, the measurement of average numbers of electrons in interplanetary space, and the presence of singly charged helium ions. The overall configuration of the Pioneer B spacecraft is discussed, and its various subsystems are described. H.S.W.

32 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; thermal stress; impact phenomena; vibration; flutter; inflatable structures; and structural tests. For related information see also: 17 Materials, Metallic; and 18 Materials, Nonmetallic.

N66-31417# Marine Engineering Lab., Annapolis, Md.
STRUCTURAL CHARACTERISTICS OF SHEET METAL EMBOSSED WITH AN IRREGULAR DESIGN
W. A. Tewes, Jr. Apr. 1966 42 p refs
(MEL-111/66; AD-633260) CFSTI: HC $2.00/MF $0.50

To reduce weight but not strength of structures, the use of sheet metal stiffened by an embossed design instead of heavier plain metal sheets is well known. The characteristics and the potential of a particular stiffened sheet were investigated. An L-shaped element (dimple) was chosen to be embossed in 0.062-inch-thick sheet metal in a multielement pattern. Under simple bending conditions, the substitution of dimpled sheets for plain sheets of the same stiffness realized a weight reduction of 18 to 59 percent. An equation for the deflection of the dimpled sheets could not be developed because there is no established theory to which the deflections would comply when the sheets were loaded to produce an anticlastic surface. The principal deficiency of the dimpled sheet is the anisotropic elastic properties that result from the pattern arrangement and discontinuity of the elements. Author (TAB)

N66-31636# Ballistic Research Labs., Aberdeen Proving Ground, Md. Exterior Ballistics Lab.
FREE VIBRATIONS OF A SLENDER BAR WITH NON-UNIFORM CHARACTERISTICS
Chi-Hung Mok and E. Allen Murray, Jr. Dec. 1965 17 p refs
(BRL-R-1305; AD-632932) CFSTI: HC $1.00/MF $0.50

The free vibrations of a slender bar with characteristics slightly different from those of a uniform one is discussed. A simple approximate solution to this problem is presented. Results from experiments conducted with a bar of variable cross-section in free–free flexural vibrations indicate that the theory adequately predicts resonant frequencies and nodal locations. Author (TAB)

N66-31546# Naval Research Lab., Washington, D. C. Shock and Vibration Information Center.
THE SHOCK AND VIBRATION BULLETIN NO. 35, PART 6
Apr. 1966 373 p refs 35th Symp. on Shock, Vibration and Assoc. Environments held at New Orleans, 25–28 Oct. 1965 (AD-633076) CFSTI: HC $7.00/MF $1.75

Papers on shock testing methods, equipment, and specification of shock are presented. For individual titles see N66-31547–N66-31571.

N66-31547# Lockheed Missiles and Space Co., Sunnyvale, Calif.
SHOCK TESTING TO SIMULATE RANDOM VIBRATION PEAKS
J. A. Bailie *In* NRL The Shock and Vibration Bull. No. 35, Pt. 6 Apr. 1966 p 1–10 refs (See N66-31546 18-32) CFSTI: HC $7.00/MF $1.75

Many items of equipment in a variety of vehicles are subjected to both shock and short (nonstationary) bursts of random excitation. It is common practice to analyze these latter events as though they were stationary and measure their severity in terms of spectral density of acceleration. The errors involved and difficulties of doing this are reviewed. Actually, short bursts of random vibration are similar to random shocks, particularly when the failure, if any, is due to the single highest peak (SHP) of the response, rather than to fatigue. Author

N66-31548# Collins Radio Co., Cedar Rapids, Iowa.
10,000 g SLINGSHOT SHOCK TESTS ON A MODIFIED SAND-DROP MACHINE
Sam Marshall, La Verne Root, and Leonard Sackett (Michigan Univ.) *In* NRL The Shock and Vibration Bull. No. 35 Pt. 6 Apr. 1966 p 11–21 refs (See N66-31546 18-32) CFSTI: HC $7.00/MF $1.75

A MIL-S-4456 sand-drop shock testing machine was simply and inexpensively modified to obtain impact velocities exceeding 100 fps for small test items. The large drop platform was replaced by one of several smaller test fixtures required for the particular equipment to be shock tested. The fixture and test item are accelerated by 3/4-in. diameter shock cords resembling a slingshot. The fixture is guided in its travel by 3/8-in. diameter steel rods. The guide rods and pulley system were designed so that the spacing between the guide rods may be varied for different size fixture requirements. The velocity attained is dependent on the slingshot drop height and specimen plus fixture weight. From a 10-ft drop height, with the shock cords elongated 100 percent, the machine will accelerate a 7-lb load to a terminal velocity of 150 fps. Pulse shape and duration are determined by the impact material type and configuration. A brief study of some component and equipment shock fragility levels has been performed, and a summary of the data is presented. Author

N66-31549# Sandia Corp., Albuquerque, N. Mex.
SHOCK SPRINGS AND PULSE SHAPING ON IMPACT SHOCK MACHINES
Richard O. Brooks *In* NRL The Shock and Vibration Bull. No. 35, Pt. 6 Apr. 1966 p 23–40 refs Sponsored by AEC (See N66-31546 18-32) CFSTI: HC $7.00/MF $1.75

Results are discussed of an investigation conducted to find materials and practical shock spring designs that can be used to produce different shock pulses on impact shock machines. Various materials and design configurations were experimentally evaluated to determine through what ranges of stress, energy absorption, and initial strain ratios materials could be used to produce classical pulse shapes. Springs were designed for particular shock test conditions from this information. Typical test setups and the recorded pulse shapes (both noisy and clean) are presented. Dynamic mechanical properties were determined for several types of polymers and plastics. In addition, for rubber spring designs, the effect of unrestrained and semi-restrained boundary conditions on pulse shape are shown. Three different designs of liquid shock springs and their pulse shapes are discussed. Author

N66-31550# Lincoln Lab., Mass. Inst. of Tech., Lexington.
SHOCK TESTING A SPACECRAFT TO SHOCK RESPONSE SPECTRUM BY MEANS OF AN ELECTRODYNAMIC EXCITER
G. A. Gallagher and A. W. Adkins (Littleton Res. and Eng. Corp.) *In* NRL The Shock and Vibration Bull. No. 35, Pt. 6 Apr. 1966 p 41–45 refs (See N66-31546 18-32) CFSTI: HC $7.00/MF $1.75

A spacecraft is shock tested by means of an electrodynamic shaker, using shock response spectra instead of pulse wave forms as test criteria. The specified spectrum was that of a 0.4-ms, 375-g peak half-cycle sine pulse. Obtaining a clean pulse for 100- to 200-lb test specimens to such a specification is virtually impossible for a shaker of 24,000-lb peak random capacity, because damping of ringing encroaches severely on shaker capacity. Ranging, however, contributes appreciably to the shock response spectrum and is useful, rather than troublesome, when the spectrum is the test criterion. Rigid body calculations would indicate that the shaker was used successfully at more than eight times its rated capacity. Such calculations do not properly represent the phenomenon, although they are sometimes used. Obvious advantages in using the electrodynamic shaker for shock testing are economies of equipment and test setup time. Author

N66-31552# Sandia Corp., Albuquerque, N. Mex.
REENTRY OVERPRESSURE SHOCK SIMULATION TEST
William R. Kampfe *In* NRL The Shock and Vibration Bull. No. 35, Pt. 6 Apr. 1966 p 55–67 Sponsored by AEC (See N66-31546 18-32) CFSTI: HC $7.00/MF $1.75

A test series simulating reentry conditions during a possible overpressure blast was conducted on a large reentry vehicle (RV). The dynamic blast simulation was achieved by impacting a propelled sled into a nonpropelled sled containing the instrumented RV. The impact amplitude and duration were controlled by having cutter bars on the propelled sled and shear-shaped metal attached to the nonpropelled sled. The impact forces were distributed around the RV and applied to its shell by phenolic microballoons which completely surrounded the reentry shield surface. Before full-scale testing could begin, scale-model tests were necessary to develop the material shearing method and to select the proper material to surround the reentry shield surface. This testing technique was developed on an 18-in. high g actuator in approximately 12 months. Author

N66-31555# McDonnell Aircraft Corp., St. Louis, Mo.
STRUCTURAL AND FUNCTIONAL TESTS OF A FULL-SCALE GEMINI RENDEZVOUS AND RECOVERY SECTION AND AN AGENA TARGET DOCKING ADAPTER AS SUBJECTED TO AN ORBITAL MOORING SHOCK ENVIRONMENT

N. E. Stamm and J. F. Siller *In* NRL The Shock and Vibration Bull. No. 35, Pt. 6 Apr. 1966 p 105–109 (See N66-31546 18-32) CFSTI: HC $7.00/MF $1.75

A series of tests was conducted simulating full-scale Gemini and Agena orbital moorings, to qualify structurally and functionally the Gemini Rendezvous and Recovery (R & R) Section and Agena Target Docking Adapter (TDA) Assembly as subjected to the mooring shock environment. The R & R section and TDA assembly were each mounted on fabricated steel frameworks with the composite vehicle assemblies each simulating the mass, c.g. location, and three-axis mass moments of inertia of their respective production vehicles for an orbital configuration. Author

N66-31559# Sandia Corp., Albuquerque, N. Mex.
THE DOUBLE FORCE PROGRAMMER SHOCK TESTING METHOD—A NEW TECHNIQUE FOR CONTROLLING SHOCK PULSE WAVEFORMS
F. H. Mathews *In* NRL The Shock and Vibration Bull. No. 35, Pt. 6 Apr. 1966 p 149–161 Sponsored by AEC (See N66-31546 18-32) CFSTI: HC $7.00/MF $1.75

A shock testing technique, the double force programmer method, is described which can be used to generate a wide variety of unusual shock pulse shapes and can be applied to most shock machines. Two honeycomb springs, placed between three carriages, are used to generate the desired acceleration-time pulse on the center (test item) carriage. A test is conducted when one of the outer carriages (ram) impacts into the two stationary carriages. The strength and shape of the honeycomb springs are adjusted to produce the desired test item acceleration history. The method was used with a pneumatic actuator to shock test a 450-lb test item carriage by applying a triangular shock pulse of short rise followed by a long decay. These results are used to illustrate several problems which occurred during the test series. Analytical methods are developed which predict required honeycomb spring geometries. A parameter study is described in which effects of honeycomb rate sensitivity and restitution are investigated. Author

N66-31560# Lockheed Missiles and Space Co., Sunnyvale, Calif.
AEROSPACE SHOCK TEST SPECIFIED AND MONITORED BY THE RESPONSE SPECTRUM
K. Kuoppamaki and R. A. Rouchon *In* NRL The Shock and Vibration Bull. No. 35, Pt. 6 Apr. 1966 p 163–172 refs (See N66-31546 18-32) CFSTI: HC $7.00/MF $1.75

Laboratory data are presented on two recent developments in testing for shock: (a) a continuous frequency, constant Q, shock spectrum analysis technique; and (b) a shock spectrum synthesis technique employing electrodynamic shakers. Data presented show that shock spectrum simulation is a practical laboratory test method for general shock testing, combined shock and vibration testing, and for shock to remote areas via long signal transmission line. The present shock simulation methods are discussed, as well as the methods of specifying the shock environment. Damage potential of shock spectrum testing is compared to that of standard pulse shape testing. Inaccuracies resulting from pulse shape distortion are illustrated and the accuracy of shock spectrum simulation is compared to that of standard pulse simulation. Present electrodynamic shaker limitations are discussed and a shaker system for pyrotechnic event simulation is described. It is recommended that aerospace shock tests be specified and monitored by the response spectrum. Author

N66-31561# Naval Research Lab., Washington, D. C.
SPECIFICATION OF ACCELERATION PULSES FOR SHOCK TESTS
Irwin Vigness *In its* The Shock and Vibration Bull. No. 35, Pt. 6 Apr. 1966 p 173–183 (See N66-31546 18-32) CFSTI: HC $7.00/MF $1.75

Descriptions are given of methods by which acceleration pulses used for shock testing can be described and have their tolerance specified. Illustrations are given of measured acceleration pulses obtained from usual shock machines to illustrate differences between generated and specified shock pulse motions. From these differences it is possible to estimate what tolerances are reasonable at this time. Author

N66-31562# General Electric Co., Philadelphia, Pa.
SHOCK TESTING TO SHOCK SPECTRA SPECIFICATIONS
S. M. Ostergren *In* NRL The Shock and Vibration Bull. No. 35, Pt. 6 Apr. 1966 p 185–196 refs (See N66-31546 18-32) CFSTI: HC $7.00/MF $1.75

Shock test requirements are appearing more consistently in specifications in the form of a shock spectrum rather than a shock pulse. A shock pulse is described by a g level, pulse duration and shape, with tolerances on these parameters. A spectrum typically has no tolerance placed on it and is presented graphically. The problems the test engineer is faced with in utilization of a shock spectrum are: (a) to determine which shock pulse will produce the required shock spectrum, and (b) to demonstrate that the test requirement has been met. The paper considers theoretical and empirical methods that the engineer can use to deal with these problems. Examples are given showing how the pulse height, duration, and waveform can be determined from a given shock spectrum. Author

N66-31563# Ling Electronics, Anaheim, Calif.
ANALOG METHOD FOR STUDY OF SHOCK SPECTRA IN NONLINEAR SYSTEMS
Theodore F. Bogart, Jr. *In* NRL The Shock and Vibration Bull. No. 35, Pt. 7 Apr. 1966 p 197–207 refs (See N66-31546 18-32) CFSTI: HC $7.00/MF $1.75

An analog technique is described which was used in conjunction with shock spectrum synthesis equipment to study shock spectra in a system containing a common nonlinearity. Operational amplifiers were used to solve the simultaneous differential equations describing the response of a simulated shaker armature and mass load joined by a nonlinear spring element in the presence of damping. A cubic function generator was developed to simulate the nonlinear terms in the equations. Author

N66-31565# Air Force Systems Command, Wright-Patterson AFB, Ohio. Flight Dynamics Lab.
PROXIMITY SPECTRUM—A NEW MEANS OF EVALUATING SHOCK MOTIONS
Edward H. Schell *In* NRL The Shock and Vibration Bull. No. 35, Pt. 6 Apr. 1966 p 229–248 refs (See N66-31546 18-32) CFSTI: HC $7.00/MF $1.75

The proximity criterion indicates the effects of shock on a simple idealized equipment consisting of two uncoupled linear single degree of freedom systems mounted to a common rigid base. When the base undergoes a shock motion, the distance between the two masses varies. The change in the distance between these two systems is called the proximity criterion. In some types of failure (e.g., electrical malfunctions and collision of parts), this criterion is important. This paper develops the proximity criterion into the proximity spectrum by varying the natural frequencies of the two systems so that data can be obtained for spectral plots.

Digital computation is employed for obtaining data from a mathematical model. The technique provides means of comparing different shock motions in terms of their effects on a standard equipment. Proximity spectra of the half-sine, terminal-peak sawtooth, and rectangular shock motions are presented. Author

N66-31566# Allied Research Associates, Inc., Concord, Mass.
DEFINITION OF SHOCK DESIGN AND TEST CRITERIA USING SHOCK AND FOURIER SPECTRA OF TRANSIENT ENVIRONMENTS
M. Gertel and R. Holland *In* NRL The Shock and Vibration Bull. No. 35, Pt. 6 Apr. 1966 p 249–264 refs (See N66-31546 18-32) CFSTI: HC $7.00/MF $1.75

In connection with recent environment studies, shock and Fourier spectra for a variety of measured and idealized acceleration pulses and complex waveforms have been computed on an IBM 7094 digital computer using O'Hara's recursion equations for the Duhamel integral. These spectra have been machine-plotted in a normalized four-coordinate format similar to that proposed by Vigness using a General Dynamics SC4020 computer plotter. Several samples of computed spectra are presented and discussed. The application of shock and Fourier spectra for deriving shock design and test criteria is discussed in connection with recent measured shocks representative of missile pyrotechnic stage separation and Army tank turret gunfiring conditions. Author

N66-31567# McDonnell Aircraft Corp., St. Louis, Mo.
STRUCTURAL RESPONSE TO IMPULSIVE LOADING (PYROTECHNIC DEVICES)
Vincent S. Noonan and William E. Noonan *In* NRL The Shock and Vibration Bull. No. 35, Pt. 6 Apr. 1966 p 265–284 refs (See N66-31546 18-32) CFSTI: HC $7.00/MF $1.75

The flexible linear shaped charge and other pyrotechnic devices are used during various separation phases in the Gemini Mission Profile. Concern has been expressed regarding structural response and/or equipment malfunctions resulting from the high-acceleration high-frequency transient motions (shocks) induced in vehicle structures by separation events. In particular, separation techniques employing cutting by flexible linear shaped charges have been known to cause relay chatter and fractures of brittle parts or structure. Therefore, the structural response to impulsive loading of spacecraft structure and the effects on the performance of electronic equipment mounted to such structure have been investigated. Author

N66-31568# AVCO Corp., Wilmington, Mass. Research and Advanced Development Div.
ANALYTIC DYNAMIC MODELING FOR IMPULSIVE ENVIRONMENTS
William C. Broding and John R. Henry *In* NRL The Shock and Vibration Bull. No. 35, Pt. 6 Apr. 1966 p 285–307 refs (See N66-31546 18-32) CFSTI: HC $7.00/MF $1.75
(Contract AF 04(694)-297)

Analytic dynamic modeling techniques of suitable simplicity for the design engineer have been used successfully for the study of impulsive conditions created by pyrotechnic devices, blast, or impact. The scope of modeling considered covers only linear theory for the definition of structural overall damage within the early response time of the entire structure. Comparisons are shown of various approaches to the definition of the physical characteristics of the dynamic system, using three methods: direct-stiffness, lumped-parameter, and the Houbolt finite-difference approaches. Geometries considered are shallow spherical shells, sphere-cones, axially and laterally loaded cylinders, and elastic bars. These examples indicate that adequate analytical techniques are available for the analysis of impulsively loaded structures. Author

N66-31569# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
PYROTECHNIC SHOCK ANALYSIS AND TESTING METHODS
Alan R. Hoffman and James E. Randolph *In* NRL The Shock and Vibration Bull. No. 35, Pt. 6 Apr. 1966 p 309–329 (See N66-31546 18-32) CFSTI: HC $7.00/MF $1.75
(Contract NAS7-100)

Explosive separation devices employed during the launch phase and space flight generate a shock environment that could have a deleterious effect on the spacecraft hardware. The interpretation and simulation of these shocks in ground tests are necessary to insure equipment integrity during this phase. A detailed analysis of certain pyrotechnic shocks is presented. The data used are from the Ranger Block III and Mariner Mars test programs. Shock spectra form the basis of correlation between similar shocks of various spacecraft and assembly testing. Comparisons of shock data using statistical methods are also included. Since a wealth of shock data was available, the statistical analysis is significant. The results indicate the necessity for a system level pyrotechnic test program if the environment is to be properly simulated. Author

N66-31570# General Dynamics/Convair, San Diego, Calif.
SHAPED CHARGE SHOCK ENVIRONMENT FOR CENTAUR VEHICLE COMPONENTS
F. C. Noble, Jr. and R. L. Batten *In* NRL The Shock and Vibration Bull. No. 35, Pt. 6 Apr. 1966 p 331–351 (See N66-31546 18-32) CFSTI: HC $7.00/MF $1.75
(Contract NAS3-3232)

This paper describes the acquisition and analysis of high-frequency shock data recently obtained during three ground tests of a full-scale Centaur vehicle. These shocks were usually measured at the equipment mounts. The mounting structure shocks were produced by a linear shaped charge separation system (approximately 127 ft in length) that cuts the structural joints of the external insulation panels. A comparison is made between a ground test shock measurement and a similar flight measurement. Also, the shaped charge acoustic environment in the Centaur forward equipment area is evaluated. Shock spectra of the shock measurements several inches to 219 in. away from the shaped charge severed joints are presented and analyzed. An experience with hardware is discussed that consisted of measurement and analysis of the shock environment, as well as laboratory shock tests that aided in verifying the adequacy of the equipment to the expected shock. Author

N66-31571# Aerospace Corp., San Bernardino, Calif.
VIBRATION AND SHOCK DATA FROM THE ATHENA BOOSTER
C. J. Moening and F. J. Benedetti *In* NRL The Shock and Vibration Bull. No. 35, Pt. 6 Apr. 1966 p 353–371 (See N66-31546 18-32) CFSTI: HC $7.00/MF $1.75

Vibration and shock data measured on the ATHENA intermediate size solid propellant booster are presented. These data were measured in three orthogonal axes at two missile stations on broadband FM/FM telemetry. The two locations selected for the flight measurements were at the missile attitude controller base plate (Stage 3) and at the payload interface plate (Stage 4). During eleven flights, measurements were made in each of three orthogonal axes at the Stage 3 location. On six of these flights, measurements were also made in each of the three axes at the Stage 4 location. In addition,

ground tests were instrumented to measure the magnitude of shock induced as a result of pyrotechnic separation devices. The vibration data are presented as acceleration spectral densities and the shock data are presented as response spectra. Author

N66-31586# Naval Research Lab., Washington, D. C. Shock and Vibration Information Center.
THE SHOCK AND VIBRATION BULLETIN, NO. 35, PART 7
Apr. 1966 271 p refs 35th Symp. on Shock, Vibration and Assoc. Environments, New Orleans, 25–28 Oct. 1965
(AD-633096) CFSTI: HC $6.00/MF $1.50

Papers on prediction of vibration and shock environments, and damping and non-linear analysis are presented. For individual titles see N66-31587–N66-31610.

N66-31587# Martin Co., Denver, Colo. Aerospace Div.
TITAN III-C AERODYNAMIC VIBRATION ANALYSIS
F. M. Condos *In* Naval Res. Lab. The Shock and Vibration Bull. No. 35, Pt. 7 Apr. 1966 p 1–7 (See N66-31586 18-32) CFSTI: HC $6.00/MF $1.50

Initial estimates of acoustic levels were made from wind tunnel data scaled by the Strouhal number. These estimates were used with measured rocket acoustic noise and the resulting vibration data from previous programs to predict vibration levels. The predictions assumed the vibration increase was linear with changes in acoustic levels. Correlation between model and full scale acoustic data is fair, with some variations attributed to differences in payload shape. Full scale data indicate that maximum acoustic and vibration levels occur at maximum dynamic pressure and that this area needs to be covered thoroughly by wind tunnel tests. Comparisons of acoustic and vibration measurements indicate that possibility that aerodynamic excitation of this type may be a more efficient excitor than rocket acoustic noise. Author

N66-31588# Aerospace Corp., San Bernardino, Calif.
PREDICTION OF RE-ENTRY VIBRATION
Frank A. Smith and F. J. Benedetti *In* Naval Res. Lab. The Shock and Vibration Bull., No. 35, Pt. 7 Apr. 1966 p 9–18 refs (See N66-31586 18-32) CFSTI: HC $6.00/MF $1.50

This paper presents, in nondimensional form, recent broadband vibration data which indicate a trend toward higher vibration levels during the reentry period as compared with those during the boost period. The data are as yet insufficient both in quantity and quality to allow accurate assessment of the effect on vibration levels with all flight parameters (such as effects due to various ablative materials), although cursory checks of these data show that they tend to follow the dynamic pressure characteristics. Author

N66-31590# Boeing Co., Seattle, Wash.
HIBEX MISSILE VIBRATION ENVIRONMENT CONSIDERATIONS
J. C. Furlong and H. M. Voss *In* Naval Res. Lab. The Shock and Vibration Bull., No. 35, Pt. 7 Apr. 1966 p 25–30 refs (See N66-31586 18-32) CFSTI: HC $6.00/MF $1.50

HIBEX is a research and development program to study the feasibility of very high acceleration boost. As a short duration, limited production program, it was necessary to procure equipment on the basis of initial predictions of the vibration environment. This paper outlines the original prediction process which used an empirical vibro-acoustic transfer function, the verification of this transfer function by a full scale prototype sonic test, and finally provides a progress report on measured flight data. The evolution of vibration design and test philosophy for this class of vehicles is discussed, and the vibration levels in use for equipment qualification are compared to those actually measured in flight. Author

N66-31591# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
MARINER MARS 1964 ACOUSTICALLY INDUCED VIBRATION ENVIRONMENT
R. A. Schiffer and J. R. Hyde *In* Naval Res. Lab. The Shock and Vibration Bull., No. 35, Pt. 7 Apr. 1966 p 31–53 refs (See N66-31586 18-32) CFSTI: HC $6.00/MF $1.50
(Contract NAS7-100)

This paper discusses enhancing the probability of survival of Mariner Mars 1964 in the acoustically induced vibration environment associated with the boost phase of the mission. A brief technical description is given of the spacecraft. Two techniques were used to estimate the lift-off and transonic vibration spectra for particular locations on the spacecraft and on the spacecraft adaptor: (a) a method of measured acoustic acceptances and (b) an empirical method. Some of the Mariner ground test activities (vibration, acoustic, wind tunnel), pertinent to the extraction of parameters for use in the predicting techniques, are also given. The predictions and the flight data are compared. Deviations in the estimating parameters and their effects on the prediction, based on the flight measurements, are indicated. The adequacy and conservatism of the test requirements are shown by the spectra ratios of the behavior of the adaptor during ground tests to the corresponding maximum recorded levels during flight. Finally, a procedure for defining test requirements for future programs is recommended. Author

N66-31592# Honeywell, Inc., St. Petersburg, Fla. Aeronautical Div.
VIBRATION STUDIES CONDUCTED ON THE GEMINI INERTIAL PLATFORM
Dean Seefeld *In* Naval Res. Lab. The Shock and Vibration Bull., No. 35, Pt. 7 Apr. 1966 p 55–66 (See N66-31586 18-32) CFSTI: HC $6.00/MF $1.50

This paper summarizes the vibration studies conducted on the Gemini inertial platform. Descriptions of the hardware, the vibration problem, and the 41-degree of freedom mathematical model used in the analysis are presented, along with problems encountered in the analysis, and the overall value of the analysis. Although the platform vibration studies represent a very specialized area of interest in the field of vibration, the methods used, and findings obtained, are applicable to any small, complex structure. The Gemini platform vibration studies are also of particular interest because the platform represents a somewhat noncompliant hard-mounted structure, with a high-level random-vibration exposure requirement for both survival and performance. Author

N66-31593# McDonnell Aircraft Corp., St. Louis, Mo.
GEMINI SPACECRAFT FLIGHT VIBRATION DATA AND COMPARISON WITH PREDICTIONS
James A. Callahan *In* Naval Res. Lab. The Shock and Vibration Bull., No. 35, Pt. 7 Apr. 1966 p 67–76 (See N66-31586 18-32) CFSTI: HC $6.00/MF $1.50

The pioneering Mercury and the second generation Gemini have similar design features and are launched with similar trajectories; therefore, extrapolation from Mercury was considered realistic. The biggest difference in external shape is the presence of an escape tower on Mercury, which was significant when fluctuating pressure wind tunnel data was evaluated. It was indicated that the statistical application of Mercury data to the maximum q of the Gemini trajectory

would be conservative. Flight data from the first Gemini flight indicated an increase of vibration. Sufficient data were obtained to evaluate the environment of equipment modules in the adapter section prior to full scale testing. The second flight gave further evidence to the maximum launch vibration. A distribution of vibration along the reentry module was also obtained, as well as the first reentry data on this vehicle. General specification requirements were not further modified using this data since most equipment had already been tested satisfactorily. The added data were used to evaluate specific items whose performance variation depends on the vibration level. Author

N66-31594# ITEK Corp., Lexington, Mass.
DETERMINATION OF THE WATER IMPACT SHOCK ENVIRONMENT
F. H. Collopy *In* Naval Res. Lab. The Shock and Vibration Bull., no. 35, pt. 7 Apr. 1966 p 77–86 refs (See N66-31586 18-32) CFSTI: HC $6.00/MF $1.50

The various phases of the water entry phenomenon for reentry vehicles and the theoretical approach which can be utilized in deriving equations to describe the resulting motions are presented. Expressions for predicting the water impact force are developed for the preflow line (shock wave) phase and the flow line establishment phase. The sphere, cone, and sphere–cone configurations are considered. The full cavity steady state phase and the noncavity steady state flow are discussed. Typical force–time histories are included. The assumptions used in deriving the equations, the resulting limitations, and suggestions for application are discussed. N.E.N.

N66-31595# Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
ORBITAL VIBRATION EFFECTS ON SCIENTIFIC INSTRUMENTS
R. J. Savage *In* Naval Res. Lab. The Shock and Vibration Bull., No. 35, Pt. 7 Apr. 1966 p 87–99 refs (See N66-31586 18-32) CFSTI: HC $6.00/MF $1.50

A qualitative review has been made on the effects of orbital dynamic environments as might be experienced by a variety of scientific instruments aboard a manned orbiting spacecraft. A method has been developed for categorizing scientific instruments into sensitivity groupings by relating their electrical threshold sensitivity to the expected dynamic environment at the instrument mounting points. Ideally, if the environment at an instrument were low compared to the instrument's threshold sensitivity, or its level where malfunction commences, it could be predicted that the instrument would survive and operate properly in flight. Conversely, if the rate of sensitivity to environment approached unity, environment reduction or densensitizing the instrument would be necessary to prevent malfunction. Sensitivity tables are presented for a variety of instruments, together with a recommendation for obtaining more quantitative information on future spacecraft programs. Author

N66-31596# Purdue Univ., Lafayette, Ind. School of Aeronautics, Astronautics, and Engineering Science.
MOBILITY OF A RANDOMLY EXCITED STRUCTURE BY CROSS CORRELATION AND CROSS SPECTRAL COMPUTATION TECHNIQUES
Will Gersch and David Sharpe *In* Naval Res. Lab. The Shock and Vibration Bull., No. 35, Pt. 7 Apr. 1966 p 101–108 refs Prepared in part for Midwest Appl. Sci. Corp. (See N66-31586 18-32) CFSTI: HC $6.00/MF $1.50
(Contract NAS5-9741)

A technique is described for the estimation by digital computer of the mobility of a structure that is driven by a random excitation. Computations are based on the continuous time techniques described by Lee for the identification of the transfer function of an unknown linear system. A review is made of the continuous time linear system relationships for deterministic and stationary ergodic signals that lead to Lee's continuous time, transfer function, identification procedure. A mechanical-electrical analog is invoked for the measurement of mobility, and to demonstrate that the Lee identification procedure can be applied to the identification of the mobility of an unknown structure. The computational results suggest that a useful way to interpret the mobility computation is that, for sufficiently long record lengths, it is an unbiased estimate of the magnitude of the envelope of the signal and noise process. The utility of the heuristic model is verified by computations on a known (simulated) physical system. Author

N66-31597# Mariner Engineering Lab., Annapolis, Md.
COMPUTATION TECHNIQUES FOR MECHANICAL IMPEDANCE METHODS
James E. Smith *In* Naval Res. Lab. The Shock and Vibration Bull., No. 35, Pt. 7 Apr. 1966 p 109-117 refs (See N66-31586 18-32) CFSTI: HC $6.00/MF $1.50

It is the intent of this paper to describe a general digital computer program suitable for use on a large class of network analysis problems that are frequently encountered. The usefulness of this program stems from its applicability to different network analysis problems without revision or alteration, permitting its use by those unfamiliar with digital computers or programming languages. Mechanical network or circuit problems can assume a wide variety of forms, and because of this, the program is constructed to allow the complex variable network equations describing a particular problem to be entered into the computer as part of the problem data. This capability introduces great flexibility into the computation of a mechanical system's behavior by permitting the analysis to be performed on a set of data to be varied at will without modifying the computer program. Several examples illustrating the use of the program on typical network analysis problems are included in the paper. Author

N66-31598# Boston Naval Shipyard, Mass.
ANALYTICAL AND EXPERIMENTAL EVALUATION OF DD692 CLASS HULL VIBRATION
J. J. Francis and A. R. Paladino (Bur. of Ships, Washington, D. C.) *In* Naval Res. Lab. The Shock and Vibration Bull., No. 35, Pt. 7 Apr. 1966 p 119–135 refs (See N66-31586 18-32) CFSTI: HC $6.00/MF $1.50

This paper discusses (a) the correction of excessive hull vibration in DD692 Class Destroyers (excited by the ship's propulsion system) by utilizing a set of standard dunce caps (force generators) uniquely modified to accommodate balance weights that may be adjusted with the ship afloat by a scuba diver, and (b) the development of an analytical technique which, with the combination of experimentally established damping factors, permits the prediction of hull response to known inputs of excitation forces at various input locations. For the attenuation of excessive hull vibration, the fundamental analytical assumption underlying the operational procedure is that, of all the hull attachments which transmit excitation forces, the only significant location to affect the input of a correcting force is the main strut. For the analytical program of predicting hull excursions associated with vibration inputs of known magnitudes and locations, comparisons of actual measured values of hull vibration with the predictions

from the analytical analysis for the same force inputs at the identical location are made. Author

N66-31599# Honeywell, Inc., St. Petersburg, Fla. Aeronautical Div.

A PRACTICAL APPROACH TO THE PREDICTION OF THE NATURAL FREQUENCY OF PRINTED CIRCUIT BOARDS

James T. Arnold and Fred P. Strother, Jr. *In* Naval Res. Lab. The Shock and Vibration Bull., No. 35, Pt. 7 Apr. 1966 p 137–144 ref (See N66-31586 18-32) CFSTI: HC $6.00/MF $1.50

The design engineer is often faced with the problem of determining the natural frequency of printed circuit boards. The so-called classical approach usually assumes some combinations of free, fixed, or simply supported edges. These assumptions are not adequate for most applications. For example, typical mountings often utilize standoffs at 4, 5, 6, 7, or 8 points. Tests have been performed on a multitude of printed circuit boards and have considered size, thickness, weight, and several mounting configurations. During the tests, photographs were taken at the first and second resonances with the use of a granular powder to show nodal lines. Illustrations made from these photographs are included in the paper. The natural frequency results obtained in the tests have been correlated into an equation, which enables the prediction of natural frequency as a function of known board parameters, such as length, width, thickness, weight, modulus of elasticity, and mounting configuration. Author

N66-31600# Chrysler Corp., New Orleans, La. Space Div.

MODAL CHARACTERISTICS OF ARBITRARILY STIFFENED RINGS

John D. Sowers and Nolan P. Hymel *In* Naval Res. Lab. The Shock and Vibration Bull., No. 35, Pt. 7 Apr. 1966 p 145–156 refs (See N66-31586 18-32) CFSTI: HC $6.00/MF $1.50

Stiffness matrices for a curved-beam element of three in-plane and three out-of-plane degrees-of-freedom at a node are developed and employed to determine the natural frequencies and mode-shapes of a ring. The method is applicable to partial and complete rings of non-uniform mass and stiffness distribution and arbitrary support. Extensions of the technique to calculate breathing mode and natural frequencies of shells are illustrated. Author

N66-31601# Naval Ordnance Test Station, China Lake, Calif.

MEASUREMENT OF CAPTIVE-FLIGHT VIBRATION RESPONSE FOR AGM-45A (SHRIKE) AND FIREYE BOMB AIRBORNE WEAPONS

D. Weathersbee and W. Parmenter *In* Naval Res. Lab. The Shock and Vibration Bull., No. 35, Pt. 7 Apr. 1966 p 157–189 refs (See N66-31586 18-32) CFSTI: HC $6.00/MF $1.50

Captive-flight vibration was measured for two airborne weapons on the A-4 and F-4 aircraft. The AGM-45A (Shrike) is a guided missile and the Fireye bomb is a free-fall weapon. The two weapons have considerable differences in rigidity: the missile is a comparatively stiff structure, while the bomb is a flexible shell containing a fluid. The method of suspension is entirely different. The missile response was measured when mounted to the Aero 5A-1 launcher, and the bomb response was measured when mounted to a fully loaded multiple ejector rack (MER). The weapons are compared by power spectral density curves for various conditions of captive flight. Typical probability density amplitude curves are presented, along with rms acceleration level variation with dynamic pressure. The nature of the weapon's response is essentially broad band random vibration containing some sinusoidal components. Power distribution is predominantly in the lower half of the spectrum bandwidth for the Fireye weapon response, whereas the converse is typical of the Shrike missile response. Author

32

N66-31602# National Engineering Science Co., Pasadena, Calif.

RESPONSE OF A NONLINEAR DAMPED OSCILLATOR TO RANDOM EXCITATION

A. W. Bell and A. E. Galef *In* Naval Res. Lab. The Shock and Vibration Bull., No. 35, Pt. 7 Apr. 1966 p 191–196 refs (See N66-31586 18-32) CFSTI: HC $6.00/MF $1.50

A method for determining the response to random excitation of a simple oscillator with nonlinear damping is developed. As is always the case in random motion, the response is determined in terms of the root-mean-square response and the probability distribution. The probability distribution is found to be markedly different, in the nonlinear case, from the Rayleigh distribution found for the linear case. The effects on the probability of failure of an oscillator may, therefore, be quite profound, even when the mean-square response of the nonlinear oscillator is the same as the response of an otherwise equivalent linear oscillator. Author

N66-31603# Sandia Corp., Albuquerque, N. Mex.

MATHEMATICAL MODELS OF NONLINEAR MULTI-DEGREE-OF-FREEDOM STRUCTURES

Walter B. Murfin *In* NRL The Shock and Vibration Bull., No. 35, Pt. 7 Apr. 1966 p 197–203 refs (See N66-31586 18-32) CFSTI: HC $6.00/MF $1.50

A method is discussed for computing the response of highly nonlinear structures of very many degrees of freedom, with any type of coupling between degrees of freedom, for any type of input. Good results were obtained in computing responses of highly coupled structures of over 70 deg. of freedom with many specific nonlinearities. Predicted and experimental results are compared to demonstrate the success of the method. Methods are presented for computing responses of nonlinear ring and shell structures. Orthotropy, elastic–plastic materials, and geometric nonlinearities are included. While response calculations are well developed, less work has been done in the field of failure criteria. Some reasonable criteria are presented for survival or failure of realistic structures. The application of these criteria to mathematical models is discussed. Author

N66-31604# Radio Corp. of America, Princeton, N. J. Astro Electronics Div.

FORCE TRANSMISSIBILITIES IN SPACECRAFT STRUCTURES

Carl C. Osgood *In* Naval Res. Lab. The Shock and Vibration Bull., No. 35, Pt. 7, Apr. 1966 p 205–211 (See N66-31586 18-32) CFSTI: HC $6.00/MF $1.50

Vibration data from approximately 107 spacecraft during launching were examined for transmissibility values. The spacecraft were all launched in a cantilever mount with the input forces applied along the longitudinal axis, but the structures, materials, and methods for fabrication varied. The primary and secondary geometric and physical characteristics are identified. The damping and the resonant frequency in the first mode of the primary structure are discussed. Tables are presented for the transmissibilities and structural characteristics. It was concluded that a force transmissibility between 7 and 10 sould be a suitable value for designing metal spacecraft. N.E.N.

N66-31605# Air Force Systems Command, Wright-Patterson AFB, Ohio. Air Force Materials Lab.

ENERGY DISSIPATION IN A VIBRATION DAMPER UTILIZING A VISCOELASTIC SUSPENSION

John P. Henderson *In* NRL The Shock and Vibration Bull., No. 35, Pt. 7 Apr. 1966 p 213-229 refs (See N66-31586 18-32) CFSTI: HC $6.00/MF $1.50

A vibration damper consisting of a mass suspended on a spring made from viscoelastic material is investigated. The energy dissipation was investigated both analytically and experimentally. Analytical techniques utilizing measured values of the complex modulus of a few typical viscoelastic materials are described. The effects of changes of material properties with temperature and frequency are considered. It is shown that the damper is effective at frequencies near its undamped resonant frequency and above. An experimental technique for measuring the energy dissipated per cycle in the damper is described. This technique employs a data sampling method to reproduce low frequency replicas of the high frequency driving-point force and acceleration signals. These replicas were used to plot hysteresis loops, whose areas were a measure of the energy dissipated per cycle. Phases and amplitude calibrations and the method used for mass cancellation are discussed. Agreement between analysis and experiment is shown to be within the accuracy of most of the complex modulus data currently available for damping materials. Author

N66-31606# Dynatech Corp., Cambridge, Mass.

THE EFFECT OF STRUCTURAL DAMPING ON THE MODAL RESPONSE OF A RESONANT BEAM

Frederick C. Nelson *In* Naval Res. Lab. The Shock and Vibration Bull., No. 35, Pt. 7 Apr. 1966 p 231-237 refs (See N66-31586 18-32) CFSTI: HC $6.00/MF MF $1.50

An analytical study is made of the influence of structural damping on the first resonant mode shape of a simply supported beam. Both midpoint and quarterpoint harmonic forcing are considered. It is shown that the difference between the first resonant mode and the first natural mode increases with increasing structural damping and that the combination of large structural damping and closely spaced frequencies can result in a measurably impure resonant mode shape. The results may be useful to those engaged in resonant testing of beamlike structures which have had their structural damping heavily augmented by the application of viscoelastic material. Author

N66-31607# Lord Mfg. Co., Erie, Pa.

A SIMPLIFIED APPROACH TO STRUCTURAL DAMPING DESIGN

G. E. Warnaka, A. J. Harris, and B. W. Campbell *In* Naval Res. Lab. The Shock and Vibration Bull., No. 35, Pt. 7 Apr. 1966 p 239-251 refs (See N66-31586 18-32) CFSTI: HC $6.00/MF $1.50

Theoretical predictions of the performance of a constrained layer laminate involve the solution of a number of complicated algebraic equations. This paper shows how design charts and a specially constructed slide can be used to eliminate the iterative procedures so that estimations of structural damping can be made in a matter of minutes. The solution of extensional (unconstrained) damping problems by the use of another specially made slide rule is also discussed. The accuracy of the techniques is shown. The paper also discusses the effects of the environmental factors, frequency, and temperature, on the dynamic properties of the polymeric damping material and, hence, the damping of the composite. The use of slide rules and design charts to compensate for these effects is illustrated. Author

N66-31608# Sandia Corp., Albuquerque, N. Mex.

USE OF THE SHOCK SPECTRUM TECHNIQUE FOR NONLINEAR SYSTEMS

Walter B. Murfin *In* Naval Res. Lab. The Shock and Vibration Bull., No. 35, Pt. 7 Apr. 1966 p 253-259 refs (See N66-31586 18-32) CFSTI: HC $6.00/MF $1.50

Because the shock spectrum technique is dependent on linear simple oscillators, application of the method to nonlinear systems may be of dubious value. Several types of nonlinearities are briefly discussed. Applications of shock spectra to some specific systems are investigated. The specific nonlinear systems chosen are: (1) an elastic-plastic, strain hardening system, (2) a system with dead zone, and (3) a system with bilinear stiffness. The spectra of the responses of these systems to simple geometric pulses are examined and compared with the spectra of the corresponding linear systems. It is shown that the spectra may differ widely. Complex environmental shock pulses are investigated. Again, it is shown that the responses of linear and nonlinear systems are markedly different. The linear response spectrum is widely used to derive realizable equivalent test pulses from complex environmental pulses. The derived pulses for the linear and nonlinear systems are compared, and it is discovered that the test pulse derived for the linear system is also applicable to the nonlinear system. Author

N66-31609# IIT Research Inst., Chicago, Ill.

NOISE AND VIBRATION CONTROL WITH FIBER METALLURGY

H. B. Karplus, V. J. Raelson, and H. Schwartzbart *In* Naval Res. Lab. The Shock and Vibration Bull., No. 35, Pt. 7 Apr. 1966 p 261-265 (See N66-31586 18-32) CFSTI: HC $6.00/MF $1.50

The mechanical properties of fiber metal bodies and their potential application to noise and vibration control are discussed. The paper is, to a large extent, of a speculative nature, defining the range of properties that might be expected from these materials, opening up fields for further research. Emphasis is placed on the acoustic absorption and the mechanical elastic moduli of these materials. Author

N66-31610# Marine Engineering Lab., Annapolis, Md.

MEASUREMENT OF COMPLEX SHEAR MODULUS OF VISCOELASTIC MATERIALS BY MECHANICAL IMPEDANCE METHODS

Andrew J. Roscoe, III, E. V. Thomas, and W. Blasingame *In* Naval Res. Lab. The Shock and Vibration Bull., No. 35, Pt. 7 Apr. 1966 p 267-274 refs (See N66-31586 18-32) CFSTI: HC $6.00/MF $1.50

A method of calculating the complex shear modulus and loss tangent of a viscoelastic material using a laminated beam is described. The assumptions and the consequent limitations are indicated, and an expression for the shear modulus is developed. Long, narrow, laminated beams with elastic layers of equal thickness and a large elastic-to-viscoelastic thickness ratio were used in the testing, and the experimental technique is described. Shear storage modulus and shear loss tangent were determined from composite beam damping using different viscoelastic material thicknesses and at different temperatures. Graphs of the results are presented. N.E.N.

N66-31614# Technion Research and Development Foundation, Ltd., Haifa (Israel).

RESEARCH ON SECOND ORDER EFFECTS IN THE ELASTIC RESPONSE OF METALS Technical Report, 1 Jul. 1965-30 Jun. 1966

Markus Reiner [1966] 23 p refs
(Contract N62558-4482)
(MS-33/R2) CFSTI: HC $1.00/MF $0.50

Using the Green, Almansi, and Hencky measures of finite strain, the elastic response of a circular cylinder in torsion is calculated under the assumption that a change of length is prevented. It is found that this requires the application of axial pressures at the ends. Author

N66-31631# AVCO Corp., Wilmington, Mass. Research and Advanced Development Div.
ELASTIC STRESS ANALYSIS AND BUCKLING OF SHELLS
P. P. Radkowski *In its* Thermal Protect. Systems Jan. 1965 p 419–452 refs (See N66-31626 18-33) CFSTI: HC $9.80/MF $3.00
(Contract AF 04(694)-36)

Analytic procedures for shells of revolution are applied to the elastic stress and bucklong problem of shells having multilayer beams and plates. Considered is a heat shield bonded onto sandwiches with honeycomb or corrugated cores. A solution for non-symmetric geometry such as longitudinal cylindrical, is being analyzed for programming into high-speed digital computers. G.G.

N66-31632# AVCO Corp., Wilmington, Mass. Research and Advanced Development Div.
THE STRUCTURAL STRENGTH OF SANDWICH CYLINDRICAL AND CONICAL SHELLS SUBJECTED TO ROTATIONALLY SYMMETRIC LOADING
Joseph C. Serpico *In its* Thermal Protect. Systems Jan. 1965 p 459–524 refs (See N66-31626 18-33) CFSTI: HC $9.80/MF $3.00
(Contract AF 33(616)-7483)

A strength analysis is presented for conical and cylindrical sandwich-shell structures subjected to combined axial load and lateral pressure distributions. The sandwich construction is assumed to consist of isotropic membrane facings separated by and bonded to a full-depth honeycomb core. Parametric curves are plotted to simplify the design approach and to establish optimum design points for the existing sandwich-shell construction. Author

N66-31637# Lockheed Missiles and Space Co., Sunnyvale, Calif.
EXPERIMENTAL INVESTIGATION OF THE STABILITY OF FIBERGLASS TUBES UNDER AXIAL COMPRESSION
L. I. Vereina [1966] 7 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Otd. Tekhn. Nauk, Mekhan. i Mashinostr. (Moscow), no. 2, 1966 p 26–28
CFSTI: HC $1.00/MF $0.50

Fiberglass tubes of different lengths and boundary conditions were evaluated by longitudinal bending tests for their utilization as power poles in various structures. Uniform axial compression with elastic and inelastic strains established the influence of the edge effect on the character of the tube rupture; the use of an adapter for end plate support increased the critical stress values of the glass rods. The material's elastic moduli, the nonuniformity in wall thickness, the difference in tube material mechanical properties, and the boundary conditions all influenced the critical force factor during tension and compression modes. G. G.

N66-31666*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
AXISYMMETRIC THERMAL STRESSES IN SANDWICH SHELLS OF REVOLUTION WITH APPLICATION TO SHALLOW, SPHERICAL SHELLS
H. E. Williams 15 Jul. 1966 32 p refs
(Contract NAS7-100)
(NASA-CR-76428; JPL-TR-32-920) CFSTI: HC $2.00/MF $0.50 CSCL 20K

The problem of computing the thermal stresses in a sandwich shell of revolution with a weak core is approached by computing separately a particular solution of the equations which involve the temperature distribution, and then superposing a solution for an edge-loaded shell to satisfy the boundary conditions. The component solutions for a shallow spherical shell are included. In order to retain the effects of transverse normal and shear strain, the governing equations of equilibrium and the stress–strain relations are obtained by applying Reissner's variational principle. The particular solution for the heated shell is obtained by an order of magnitude argument and is applicable for slowly varying temperature distributions only. The solutions for the edge-loaded shell indicate that the cross influence coefficients can be obtained from those of an equivalent isotropic shell, but that the direct influence coefficients are substantially affected by the effect of transverse shear strain. The effect of transverse normal strain is appreciable only in the particular solution. Author

N66-31670*# Martin Co., Denver, Colo.
BUCKLING OF IMPERFECT CYLINDERS UNDER AXIAL COMPRESSION
G. A. Thurston and M. A. Freeland Washington, NASA, Jul. 1966 51 p refs
(Contract NAS1-4782)
(NASA-CR-541) CFSTI: HC $3.00/MF $0.50 CSCL 20K

A solution is presented for Donnell's equations for an imperfect cylinder subjected to axial compression. Newton's method is used to reduce the nonlinear partial differential equations to a sequence of linearized equations. The linear equations are solved numerically by applying Galerkin's method. Buckling loads are computed for several imperfection shapes, including the axisymmetric imperfections considered by Koiter. Some postbuckled solutions are also reported. Author

N66-31736# Netherlands Research Centre TNO for Shipbuilding and Navigation, Delft.
ROLL DAMPING BY FREE SURFACE TANKS
J. J. Van Den Bosch and J. H. Vugts Apr. 1966 49 p refs *Its* Rept.-83-S
(TDCK-45478) CFSTI: HC $2.00/MF $0.50

The problem of a free surface tank as a roll damping device is discussed. The wave phenomena in the tank are described and it is pointed out that the roll damping is essentially based on the existence of a hydraulic jump or bore. Quantitative information on the counteracting moment, caused by the water transfer in the tank, is provided. Under the assumption of a pure rolling motion in beam waves calculations are performed to show the reduction in rolling and athwartship's accelerations. A general procedure to design a free surface tank for this case is presented. The procedure is illustrated by an example. Author

N66-31740# Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Mulheim an der Ruhr (West Germany).
MAXIMUM LOADING OF TRANSVERSELY STRUCK ELASTIC PLATES [MAXIMALE BEANSPRUCHUNG SCHLAGARTIG BELASTETER ELASTISCHER PLATTEN]
H. Schwieger May 1966 70 p refs In GERMAN; ENGLISH summary
(DLR-FB-66-33; DVL-503) CFSTI: HC $2.50/MF $0.75

Combining some theories, it is possible to calculate at first the impact forces for different values of an impact parameter and then, for a certain characteristic impact-value, to divide the time slope of the contact force in a sequence of separate rectangular force curves. Later, the parts of the central bending moments due to these jump curves can be calculated in a simple way using these separate loading curves. The sum of these parts yields the time function of the central bending moment. This simplified theory is valid for large plates in which the elastic waves reflecting from the boundaries of the plate have no influence on the central maximum state of stress. The results of this theory, i.e., especially the central bending moments, where verified by measurements with strain-gages and photostress-method. The agreement was satisfactory. Author

N66-31844# Netherlands Research Centre TNO for Shipbuilding and Navigation, Delft.
BRITTLE FRACTURE OF FULL SCALE STRUCTURES DAMAGED BY FATIGUE [HET BROS BREKEN VAN CONSTRUCTIES DIE DOOR VERMOEIING BESCHADIGD ZIJN]
J. J. W. Nibbering, J. Van Lint, and R. T. Van Leeuwen (Delft Technol. Univ.) May 1966 32 p refs *Its* Rept.-85S (TDCK-45619) CFSTI: HC $2.00/MF $0.50

Tests are discussed with full scale structural specimens which were loaded to rupture at low temperatures after being subjected to low cycle fatigue loading. (Axial loading: $P_{min}/P_{max}=-1/2$). It has been found that fatigue seriously reduces the plastic deformability prior to brittle fracture. This seems to be mainly due to the presence of fatigue cracks and not to deterioration of the material caused by the fatigue loading. The influence of crack length was small. The high stress–low stress transiton of the specimens was much lower than transition temperatures obtained with well-known acceptance tests. In an additional investigation it could be proved that this large difference is a consequence of the pure static character of the final tests to rupture. The results strongly suggest that the high stress–low stress transition of the full scale specimens might be raised up to nil ductility transition by pure elastic shock loading. Author

N66-31930*# General Dynamics/Convair, San Diego, Calif.
DYNAMIC LOADS ANALYSIS OF SPACE VEHICLE SYSTEMS—LAUNCH AND EXIT PHASE
Raymond H. Schuett, Bruce A. Appleby, and Jack D. Martin Jun. 1966 246 p refs Prepared for JPL
(Contracts NAS7-100; JPL-950994)
(NASA-CR-76502; GDC-DDE66-012) CFSTI: HC $3.75/MF $1.50 CSCL 20K

Basic analytic methods used to solve structural dynamics problems are discussed with relation to dynamic loads encountered during the launch and exit phases. These techniques are summarized, and numeric examples are given to illustrate procedures and typical results using the Atlas–Centaur–Surveyor as a model. Various aspects of the loads induced by ground winds are discussed, and a method of calculating these loads is presented. Rigid body and vibratory loads at engine start and shutdown, liftoff from the launch pad, and steady-state loads between these times are analyzed, and the major problems i.e., adequate description of a longitudinal mathematical model and the time history of applied forces, are discussed. Loads due to atmospheric disturbance, from wind and gusts and buffet, are described and procedures for calculating these loads are given. Vehicle response as a function of forcing frequency is analyzed, and the importance of damping of the system in the response solution is emphasized. A typical rigid-body analysis for jettisoning of a fairing is presented, and the elastic effects as well as typical problems involved with separation in general are discussed. L.E.W.

N66-31957# College of Aeronautics, Cranfield (England).
RECENT AEROELASTIC INVESTIGATIONS AT THE COLLEGE OF AERONAUTICS
D. J. Johns Jan. 1965 36 p refs
(CoA-AERO-168) CFSTI: HC $2.00/MF $0.50

Summaries are given of research conducted in various areas of aircraft design and aerodynamics during the period between 1958 and 1963. Research centered on studies of panel, membrane and wing instabilities, investigations associated with the Morane–Sauliner 760 aircraft, investigation on design project studies, and helicopter problems. Some of the specific topics covered are: supersonic flutter of panels and cylindrical shells, subsonic divergence of rectangular plane panels, elevator flutter of T-tail aircraft, static aeroelastic problems, supersonic delta wing airliner design, VTOL freighter design, and helicopter ground resonance. A list of both published and unpublished reports that were generated by this research is also included. H.S.W.

N66-32070*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A THEORETICAL BASIS FOR MECHANICAL IMPEDANCE SIMULATION IN SHOCK AND VIBRATION TESTING OF ONE-DIMENSIONAL SYSTEMS
F. J. On and R. O. Belsheim *In its* Publ. of Goddard Space Flight Center, 1963, Vol. II [1963] p 762–775 refs (See N66-32044 18-31) CFSTI: HC $7.00/MF $5.00

The feasibility of mechanical impedance control and simulation in environmental shock and vibration testing of mechanical structures was investigated theoretically. Fundamental and useful mathematical expressions for impedance are given for the analysis, control, and simulation in mechanical structures that can be considered as one-dimensional linear-passive systems. The validation of these expressions in the application to impedance control and simulation is approached primarily from analytical considerations. General theories of application are summarized along with a few simple examples of specific cases. The overall results of the investigation, as well as certain conclusions that may be drawn, are discussed. Several recommendations are made in connection with the information obtained from this study. Author

N66-32081*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A FINITE DIFFERENCE SOLUTION FOR THE TRANSVERSE VIBRATION OF A RECTANGULAR PLATE WITH INTERNAL VISCOUS DAMPING SUPPORTED AT A FINITE NUMBER OF POINTS UNDER GENERAL BOUNDARY CONDITIONS
C. A. Wagner *In its* Publ. of Goddard Space Flight Center, 1963, Vol. II [1963] p 1001–1024 (See N66-32044 18-31) CFSTI: HC $7.00/MF $5.00

Critical support vibrations of solar spacecraft panels during the launch-burnout phase were analyzed by applying the finite difference equations of equilibrium, boundary restraint, and initial conditions to the case of transversely loaded vibrating thin plates. Vibratory and state of stress phases at a finite number of points on the plate were calculated by the step method. No actual solutions were obtained, but specific examples of input parameter specifications for all simple and all free edge supports are presented. G.G.

N66-32088# Liege Univ. (Belgium). Laboratoire d'Aeronautique.
UPPER AND LOWER BOUNDS IN SPAR MATRIX ANALYSIS

G. Sander Aug. 1965 47 p
(Contract AF 61(052)-892)
(SA-3; AD-632929) CFSTI: HC $2.00/MF $0.50

A complete theory of displacement and equilibrium is given for the matrix analyses of spar elements; and numerical results are presented for a concentrated tip load, an constant distributed load, and a Dirac measure for the distributed load. The linear and quadratic approaches were used with the displacement model; and it is shown that for the quadratic approach the deflections and rotations at both ends of the spar are, in the case of arbitrary loading, independent of the number of elements into which the spar is subdivided. The stiffness matrix of the equilibrium models of the spar element are analyzed by two approaches: (1) in one, the number of generalized forces is higher than the number of stress field parameters so that two kinematical modes of deformation appear in the solution; and (2) in the other, the kinematical modes do not appear even though the same violation of stress continuity is accepted as a condition. The guarantee of an upper bound no longer holds for the latter case, but there are no significant differences between results obtained by the two methods. M.W.R.

N66-32123*# California Univ., Berkeley. Structural Engineering Lab.

A BENDING ANALYSIS OF ELASTIC-PLASTIC CIRCULAR PLATES

M. Khojasteh-Bakht, S. Yaghmai, and E. P. Popov Apr. 1966 164 p refs
(Grant NsG-274)
(NASA-CR-76540; SESM-66-4) CFSTI: HC $5.00/MF $1.00 CSCL 20K

This report is concerned with the problem of elastic-plastic bending of circular plates with axi-symmetric loading and support conditions. Incremental theory of plasticity with von Mises yield condition, and associated flow rule together with the Kirchhoffean small deformation theory of plates have been adopted. Finite element type of approach using direct stiffness method of matrix analysis of structures was employed. An annular plate is taken as the primary element which is subdivided along its depth into a number of layers. The material properties are assigned to each layer, and stiffness matrix of the element has been established. Loadings are applied in increments. Examples of simply supported and clamped circular plates made of elastic-perfectly plastic as well as elastic-plastic with isotropic strain hardening materials are given. Other support conditions and material properties can be treated. The effect of change of material properties within each increment of loading, number of elements, and number of layers have been studied. Author

N66-32175# General Electric Co., Cincinnati, Ohio. Advanced Engine and Technology Dept.

APPLICATION OF ADVANCED FIBROUS REINFORCEMENT COMPOSITE MATERIALS Monthly Progress Report, 1-31 Mar. 1966

20 Apr. 1966 78 p
(Contract AF 33(615)-3262)

This report covers work performed during this period on the application of advanced fibrous reinforced composite materials. Included are activities in the development and application of boron filament reinforced polymer and metallic base composites, payoff and associated studies for the use of composite components in aircraft gas turbine engines, and the demonstration of several key components including compressor blades, vanes, and integral rotors. The objectives, accomplishments, and future plans of the various areas of activity are presented. Author

N66-32183# General Technology Corp., Torrance, Calif.

STRESS ANALYSIS OF TWO INTERSECTING CYLINDRICAL SHELLS Quarterly Progress Report, Period Ending 20 Dec. 1965

[1965] 9 p
(Contract NObs-90157)
(QPR-21)

This report briefly describes the progress made during this period on an analysis of stress distribution and deformation in two normally intersecting cylindrical shells subject to internal pressure. Efforts on solving problems of vertical shear loading, in-plane moment loading, and out-of-plane loading in cylindrical shells are also mentioned. R.N.A.

N66-32200# Israel Inst. of Tech., Haifa. Dept. of Aeronautical Engineering.

ON THE STABILITY OF ECCENTRICALLY STIFFENED CYLINDRICAL SHELLS UNDER AXIAL COMPRESSION Scientific Report No. 4

Josef Singer, Menahem Baruch, and Ovadia Harari Dec. 1965 55 p refs
(Grant AF-EOAR-63-58)
(TAE-44; AD-630392) CFSTI: HC $3.00/MF $0.50

The eccentricity effect of stiffeners is studied for stiffened cylindrical shells under axial compression. Classical simple supports and classical clamped ends are considered. A detailed physical explanation of the causes of the eccentricity effect and its behavior is proposed and verified by computations for 350 typical shells. As for buckling under hydrostatic pressure and torsion studied earlier, the behavior of the eccentricity effect in the case of axial compression also depends very strongly on the geometry of the shell, represented by the Batdorf parameter, while the geometry of the stiffeners only influences its magnitude. Inversion of eccentricity effect occurs at very low Z, but for practical dimensions outside stringers always stiffen the shell more than inside ones. The eccentricity effect has a pronounced maximum at practical values of Z, and the behavior of the eccentricity effect is very similar for clamped and simply supported shells. Rings, which are much less effective stiffeners than stringers under axial compression, are also considered. Results are compared with those of other investigators. Author (TAB)

N66-32226*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

MEETING ON GROUND WIND LOAD PROBLEMS IN RELATION TO LAUNCH VEHICLES

[1966] 479 p refs Meeting held at Langley Res. Center, 7-8 Jun. 1966
(NASA-TM-X-57779) CFSTI: HC $5.29/MF $2.25 CSCL 01A

Symposium papers on specific vehicle results, definition of atmospheric inputs, experimental and analytical simulation techniques, and basic studies of cylindrical bodies are presented. For individual titles see N66-32227-N66-32250.

N66-32227*# National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.

HIGHLIGHTS OF GROUND-WING TESTS AT AMES

Donald A. Buell *in* NASA. Langley Res. Center Meeting on Ground Wind Load Probl. in Relation to Launch Vehicles [1966] 9 p (See N66-32226 18-32) CFSTI: HC $5.29/MF $2.25

The oscillatory loads perpendicular to the airstream for specific configurations of launch vehicles are discussed. Reynolds number and reduced frequency were assumed to be the most important factors in the vehicle simulation, and representative full scale Reynolds numbers were obtained in model tests by operating at abnormally high air densities and velocities. The effects due to shape of slender and blunt nosed models and conduit effects are discussed. It was concluded that factors such as roughness, damping, stiffness, and relative density ratio may profoundly affect the amplitude of the response. Furthermore, blunt nose shapes can have a controlling influence on model excitation, and conduits can increase or decrease the excitation depending on their location relative to the wind and to each other. N.E.N.

N66-32228*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

SUMMARY OF LANGLEY WIND-TUNNEL STUDIES OF GROUND WIND LOADS ON LAUNCH VEHICLES

Moses G. Farmer and George W. Jones, Jr. *In its* Meeting on Ground Wind Load Probl. in Relation to Launch Vehicles [1966] 25 p refs (See N66-32226 18-32) CFSTI: HC $5.29/MF $2.25

Ground wind loads have been investigated for a large number of specific launch vehicle configurations in the Langley transonic dynamics wind tunnel. An examination of typical results obtained for the Saturn V vehicle has indicated several interesting features. When the structural damping is moderately low lateral dynamic response apparently associated with vortex shedding from the lower two stages of the vehicle produces loads in excess of the design loads for the vehicle. These large responses occurred at conditions corresponding to a Strouhal number $\frac{fd}{V}$ of about 0.2 where d is the diameter of the lower stages and f is the frequency of the fundamental bending mode. The response had characteristics similar to a single-degree-of-freedom flutter and it was found that moderate increases of the structural damping reduced the response to acceptable levels and changed its character to that of a lightly damped system responding to a random input. To take advantage of these beneficial effects of increased damping, a viscous damper has been incorporated in the full-scale vehicle launch complex. Author

N66-32229*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

SATURN V GROUND WINDS PROGRAM

Robert M. Hunt *In* NASA. Langley Res. Center Meeting on Ground Wind Load Probl. in Relation to Launch Vehicles [1966] 11 p refs (See N66-32226 18-32) CFSTI: HC $5.29/MF $2.25

The concept on Saturn V was to budget an amount for the dynamic portion of the wind load as a factor on the steady state drag. Wind tunnel tests paralleled the development and fabrication phases. The results indicated that the system was unable to withstand the design winds; thus, a decision was made to implement a viscous damper fix on the facility vehicle. Damping tests in the vertical assembly building will have been completed and response tests on the pad will be in progress at the time of this symposium. This paper will present the history and status of this program to date. Author

N66-32230*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

A FULL-SCALE GROUND WIND LOAD PROGRAM

Jerome T. Foughner, Jr., and Rodney L. Duncan *In its* Meeting on Ground Wind Load Probl. in Relation to Launch Vecles [1966] 17 p refs (See N66-32226 18-32) CFSTI: HC $5.29/MF $2.25

Two surplus launch vehicles, a Jupiter and a Thor, have been erected for the purpose of research on ground wind loads. The paper indicates program objectives and presents initial results in the form of drag and lateral dynamic response on each vehicle. A response power spectrum for the Thor vehicle is discussed. A preliminary comparison of the dynamic bending moment response of the Jupiter vehicle with available wind tunnel model data combined with theoretical predictions of response due to turbulence indicates poor agreement. Author

N66-32231*# Aerospace Corp., El Segundo, Calif.

GROUND WIND INDUCED OSCILLATIONS OF THE TITAN III ITL TRANSPORTER

J. Michael Lyons and Albert J. I. Lum *In* NASA. Langley Res. Center Meeting on Ground Wind Load Probl. in Relation to Launch Vehicles [1966] 30 p refs (See N66-32226 18-32) CFSTI: HC $5.29/MF $2.25

The empty Titan III-C launch vehicle transporter was observed to oscillate in both moderate and high winds. In two instances the structure was damaged. To understand and solve the problem, theoretical flow models of the aerodynamic phenomena were postulated, and a series of aerodynamic and mechanical fixes were designed to reduce or eliminate the ground wind induced oscillations of the transporter. A wind tunnel test was then conducted with dynamically scaled models of both the transporter and launch vehicle to (1) reproduce the phenomena; (2) define the problem; and (3) determine suitable fixes to eliminate the transporter problem without inducing any oscillation problems with the launch vehicle. A suitable fix was determined and the transporter is now being modified accordingly. The results of the wind tunnel test are presented and compared with the pretest estimates. The significant aerodynamic phenomena are discussed. Author

N66-32232*# National Physical Lab., Teddington (England). Aerodynamics Div.

AERODYNAMIC EXCITATION OF STRUCTURES BY WIND—A REVIEW OF RECENT WORK AT THE NPL

R. E. Whitbread *In* NASA. Langley Res. Center Meeting on Ground Wind Load Probl. in Relation to Launch Vehicles [1966] 16 p refs (See N66-32226 18-32) CFSTI: HC $5.29/MF $2.25

Wind tunnel investigations of models scaled aeroelastically were made to determine ground wind effects on chimneys, towers, and tall building structures. Expressions are presented for aerodynamic force and damping, and the excitation measurements are considered. Preventative devices for chimneys are mentioned. Wind tunnel stability tests on different multi-cylinder configurations, slender tapered structures, and of structures in close proximity are described. The effects of straking, flue arrangement, tower configuration, and multi-structure arrangement are discussed. N.E.N.

N66-32233*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

CONSIDERATIONS AND PHILOSOPHY OF GROUND WINDS CRITERIA FORMULATION

William W. Vaughan *In* NASA. Langley Res. Center Meeting on Ground Wind Load Probl. in Relation to Launch Vehicles [1966] 31 p refs (See N66-32226 18-32) CFSTI: HC $5.29/MF $2.25

The various practical design and operational considerations involved in establishing ground winds criteria for aerospace vehicle developments are presented. The concept of

exposure period probabilities in terms of risk to vehicles exposed to wind loading during operations is considered. Applications of extreme value statistics to wind design criteria and the use of spectral methods to represent the time-dependence structure of ground winds are discussed. Author

N66-32236*# Western Ontario Univ., London.
THE RELATIONSHIP OF WIND STRUCTURE TO WIND LOADING
Alan G. Davenport *In* NASA. Langley Res. Center Meeting on Ground Wind Load Probl. in Relation to Launch Vehicles [1966] 20 p refs (See N66-32226 18-32) CFSTI: HC $5.29/MF $2.25

The mean wind velocity and wind gusts are discussed to determine for structural design purposes the maximum stresses and deflexions likely to occur. The difficulties in trying to define wind climate independent of the boundary layer characteristics are mentioned. The distribution of mean wind speeds, and the longitudinal component of velocity of turbulence near the ground are discussed. Graphs of wind speed distributions, wind profiles, and correlations are presented. It was concluded that wind distributions and profiles can be well represented and estimated, and that the earth's boundary layer and wind climate are influenced by the roughness of the terrain. N.E.N.

N66-32238*# Western Ontario Univ., London.
AN APPROACH TO THE WIND-TUNNEL MODELLING OF THE RESPONSE OF STRUCTURES TO THE NATURAL WIND
Alan G. Davenport *In* NASA. Langley Res. Center Meeting on Ground Wind Load Probl. in Relation to Launch Vehicles [1966] 13 p (See N66-32226 18-32) CFSTI: HC $5.29/MF $2.25

A historical narrative of the application of wind tunnels to structural engineering problems is presented. Experiments on steady pressure, on the dynamics of structures and turbulent boundary layer flow, and the dynamic responses of hyperbolic cooling towers are mentioned. Problems connected with atmospheric simulation and the degree of success in simulation are included. N.E.N.

N66-32239*# Martin Co., Denver, Colo.
PREDICTIONS AND IMPLICATIONS OF THE FLOW FIELD PARAMETER ANALYSIS OF THE WIND INDUCED OSCILLATION PROBLEM
Wayne E. Simon *In* NASA. Langley Res. Center Meeting on Ground Wind Load Probl. in Relation to Launch Vehicles [1966] 29 p ref (See N66-32226 18-32) CFSTI: HC $5.29/MF $2.25
(Contract NAS8-5322)

The fundamental ideas of flow field parameter analysis and application to the case of a launch vehicle standing alone are reviewed. The representations of drag and pressure distribution on the vehicle, the effects of the tower on the mean velocity, and position of the vehicle in the tower wake are discussed. The analysis is illustrated by application to Saturn V models. Graphs are included of predicted and experimental wind tunnel data. N.E.N.

N66-32243*# Massachusetts Inst. of Tech., Cambridge. Dept. of Aeronautics and Astronautics.
SOME WATER TABLE EXPERIMENTS ON OSCILLATING CYLINDERS
Leon Schindel and Garabed Zartarian *In* NASA. Langley Res. Center Meeting on Ground Wind Load Probl. in Relation to Launch Vehicles [1966] 20 p refs (See N66-32226 18-32) CFSTI: HC $5.29/MF $2.25
(Contract NAS8-20186)

This paper presents some preliminary results of forced and free oscillation tests on small cylinders in a water table flow, at Reynolds numbers of the order of 10^4. These simple, exploratory experiments consisted primarily of wake-visualization studies, and measurements of the phase angles between lateral displacements and lateral hydrodynamic forces at various amplitudes and reduced frequencies. It was found that negative hydrodynamic damping exists only at reduced frequencies within a few percent of the Strouhal number and for a limited range of amplitude. Using the hydrogen bubble technique, vortex trajectories behind stationary and oscillating cylinders were determined. Large lateral wake movements were noted, particularly for cases with large-amplitude oscillations. These results may guide and test the formulation of a simple analytical model for the purpose of predicting adequately the aerodynamic forces on an oscillating cylinder. Two such models are suggested and briefly discussed. Author

N66-32247*# Toronto Univ. (Ontario). Inst. for Aerospace Studies.
THEORY OF THE RESPONSE OF A SLENDER VERTICAL STRUCTURE TO A TURBULENT WIND WITH SHEAR
Bernard Etkin *In* NASA. Langley Res. Center Meeting on Ground Wind Load Probl. in Relation to Launch Vehicles [1966] 15 p (See N66-32226 18-32) CFSTI: HC $5.29/MF $2.25

A theory is given for calculating the response spectra of a vertical structure exposed to a horizontal turbulent wind. The method of modal representation is used to lead to spectra and cross-spectra of the driving forces for the different modes. The mean wind and the turbulence properties are both allowed to be functions of height to allow for wind shear. The result is in the form of double integrals for the relevant spectra, which can be evaluated readily by numerical integration when the appropriate data for the wind and the structure are available. Author

N66-32250*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
WHERE DO WE GO FROM HERE?—THE DESIGNER'S VIEWPOINT
In its Meeting on Ground Wind Load Probl. in Relation to Launch Vehicles [1966] 6 p (See N66-32226 18-32) CFSTI: HC $5.29/MF $2.25

Concluding remarks are presented, and the need for more basic research on ground wind effects on launch vehicles and ground support equipment was emphasized. It was considered that the lack of definition of aerodynamic forcing functions is one of the designer's major problems. The difficulties resulting from insufficient knowledge are indicated, and the value of atmospheric turbulence simulation in wind tunnels is discussed. N.E.N.

N66-32258*# Schjeldahl (G. T.) Co., Northfield, Minn.
DEVELOPMENT OF A 425 FOOT DIAMETER PASSIVE COMMUNICATION SATELLITE WITH SELF-ERECTING PROPERTIES Quarterly Progress Report No. 8 and Monthly Progress Report, May 1966
William Jacobi [1966] 36 p
(Contract NAS5-3943)
(NASA-CR-76677) CFSTI: HC $2.00/MF $0.50 CSCL 22B

Progress is reported on a program to develop a material with the ability to erect without an inflation system or external aids, with an open mesh configuration 90% transparent to solar radiation, with sufficient rigidity to withstand solar pressure having a safety factor of 5.0, and an RF reflectivity 95–98% that of a similar solid surface. During this period various sizing materials were investigated and the results are presented. An experiment was designed to determine the heat treatment required for highest rigidity. Results of a preliminary study of vacuum deposited aluminum as the conductive coating are included. A method for evaluating the rigidity after folding was developed and the test results are presented. High speed motion pictures were made of several cylinders to examine the material during deployment. R.N.A.

N66-32322# Arcos, S. A., Brussels (Belgium).
STUDY OF RESIDUAL STRESSES GENERATED IN WELDED JOINTS MADE BY THE ELECTROSLAG WELDING PROCESS [ETUDE DES CONTRAINTES RESIDUELLES ENGENDRESS PAR LE PROCEDE DE SOUNDAGE VERTICAL MONTANT]
W. Soete, J. Lemoine (Gand Univ.), M. Lefevre, A. Vinckier, and A. Berghmans Brussels, EURATOM, May 1966 145 p refs In FRENCH; ENGLISH summary
(Contract EURATOM-053-61-12 RDB)
(EUR-2801.f; EURAEC-1562) CFSTI: HC $3.00/MF $1.00

The research related to the determination of the residual surface stresses and the study, development and application of methods for the determination of the internal stresses, in the case of single-pass welds carried out by the electroslag and electrogas procedures on the plates varying in thickness from 15 to 100 mm. Also studied were the influence of the latter factor on the thermal conditions, the deformations and the stresses, as well as the heat-input and the shape and size of the molten pool. Author

N66-32325# Institut Franco-Allemand de Recherches, St. Louis (France).
RESPONSE OF HOMOGENEOUS STEEL PLATES TO STATIC AND DYNAMIC LOADS [REPONSE DE PLAQUES HOMOGENES EN ACIER A DES SOLLICITATIONS STATIQUES ET DYNAMIQUES]
Chr. Thery and Ch. Johe 2 Sep. 1965 37 p ref In FRENCH
(ISL-T-28/65) CFSTI: HC $2.00/MF $0.50

The behavior of steel plates under pressure conditions similar to those caused by nuclear explosions is examined and subsequently compared with pressures on identical plates exerted by purely static loads. The plates were in turn (1) subjected to evenly distributed static pressures; (2) subjected to pressures waves that caused deformations in the elastic range; and (3) subjected to pressure waves that caused deformations in the plastic range. The buckling in one of the plates previously deformed was straightened out in a controlled process. Transl. by K.W.

N66-32329*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
EXPERIMENTS TO DETERMINE THE STRENGTH OF FILAMENT-WOUND CYLINDERS LOADED IN AXIAL COMPRESSION
Michael F. Card Washington, NASA, Aug. 1966 38 p refs
(NASA-TN-D-3522) CFSTI: HC $2.00/MF $0.50 CSCL 20K

Results of compression tests conducted on 51 multilayered glass-epoxy cylinders are presented. Tests were conducted at both room temperature and elevated temperatures on cylinders having various helical wrap angles, matrix materials, and diameters. Experimental results indicate that, in some of the cylinders, failures were induced by buckling whereas, in others, failures were induced by thermal degradation and/or nonlinearity in the stiffness of the matrix material in the cylinder wall. The data obtained from the unheated cylinders are compared with buckling predictions based on linear anisotropic shell theory and with material strength predictions based on anisotropic yield criteria. The comparison indicated that agreement obtained between buckling tests and theoretical predictions was comparable to that obtained in previous experience with metal cylinders and that strength predictions were overly conservative. The results suggest that the compressive strength of a filament-wound cylinder can be limited by its material strength and that more refined material strength analyses are needed for multilayered fibrous composites loaded in axial compression. Author

N66-32394# Illinois Univ., Urbana. Dept. of Theoretical and Applied Mechanics.
SIXTH STUDENT SYMPOSIUM ON ENGINEERING MECHANICS
D. C. Holloway, S. A. Kiger, T. K. Meagher, C. C. Nelson, and R. T. Weiss Jun. 1966 58 p refs Symp. held at Urbana, Ill., 4 Jun. 1966
(T&AM-289)

CONTENTS:

1. COMPARISON OF THREE EXPERIMENTAL TECHNIQUES FOR ANALYZING STRESS D. C. Holloway 13 p refs

2. A STUDY OF CRACK PROPAGATION BY DYNAMIC PHOTOELASTICITY R. T. Weiss 9 p refs

3. STRESS FUNCTIONS FOR PLANE LINEAR ELASTICITY WITH COUPLE STRESSES S. A. Kiger 6 p refs

4. INFLUENCE OF TEMPERATURE ON CRACK TOUGHNESS OF MILD STEEL T. K. Meagher 12 p refs

5. EFFECT OF STRAIN CYCLING ON A HARD STEEL C. C. Nelson 11 p refs

N66-32400# Douglas Aircraft Co., Inc., Santa Monica, Calif. Structures and Mechanical Dept.
VIBRATIONS OF CYLINDRICAL PANELS AND RECTANGULAR PLATES CARRYING A CONCENTRATED MASS
R. Chen Nov. 1965 33 p refs
(Douglas Paper-3702)

A Fourier expansion approach is applied to a set of Donnell-type dynamical shell equations to obtain the natural frequencies of a simply supported cylindrical thin panel carrying a concentrated mass. Also, equations of motion for plates carrying a concentrated mass are derived through application of a limiting process to the equations of motion for the panels. Included are numerical examples for both panels and plates carrying a concentrated mass at their centers. The results for plates and panels with no attached mass are verified with known results. Author

N66-32426*# Northwestern Univ., Evanston, Ill. Structural Mechanics Lab.
MODELS DEMONSTRATING INSTABILITY OF NONCONSERVATIVE MECHANICAL SYSTEMS Technical Report No. 66-4
G. Hermann, S. Nemat-Nasser, and S. N. Prasad Jun. 1966 37 p refs
(Grant NsG-605)
(NASA-CR-76763) CFSTI: HC $2.00/MF $0.50 CSCL 20K

Nine different models are described which serve the purpose of demonstrating instability of equilibrium of mechani-

cal systems subjected to follower forces. Such forces are nonconservative, nondissipative, and are also called circulatory forces. Instability is observed to occur by either divergence (static instability, attainment of another equilibrium position) or flutter (dynamic instability, oscillations with increasing amplitudes). The connection between some of these models and related nonconservative problems of elastic stability considered analytically in the past is indicated. Author

N66-32548*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

FLUTTER AT MACH 3 OF THERMALLY STRESSED PANELS AND COMPARISON WITH THEORY FOR PANELS WITH EDGE ROTATIONAL RESTRAINT

John L. Shideler, Sidney C. Dixon, and Charles P. Shore Washington, NASA, Aug. 1966 29 p refs

(NASA-TN-D-3498) CFSTI: HC $1.00/MF $0.50 CSCL 20K

An investigation was conducted at a Mach number of 3 in the 9- by 6-foot thermal structures tunnel to study effects of thermal stress and buckling on the flutter characteristics of initially flat isotropic panels with length–width ratios of 2.5 and 2.9. The experimental results are presented in tabular form and are summarized graphically in terms of nondimensional flutter parameters. Comparison of experimental results with theory that accounts for edge rotational restraint showed good agreement at zero midplane stress and over a major portion of the flat panel flutter boundary. The theory was based on two-dimensional static aerodynamics. In the region of the transition from the flat panel boundary to the postbuckled boundary the agreement becomes poor. However, it is believed that accounting for panel initial imperfections in the theory may improve agreement between experiment and theoretical flutter boundaries in the transition region. Author

N66-32549*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

A THEORETICAL ANALYSIS OF THE FLUTTER OF ORTHOTROPIC PANELS EXPOSED TO A HIGH SUPERSONIC STREAM OF ARBITRARY DIRECTION

Peter A. Gaspers, Jr. and Bass Redd Washington, NASA, Aug. 1966 32 p refs

(NASA-TN-D-3551) CFSTI: HC $2.00/MF $0.50 CSCL 20K

A theoretical analysis of the flutter of flat, rectangular, orthotropic panels at various angles of orientation with respect to the flow direction is presented. The analysis is based on linear small deflection plate theory and static strip theory for aerodynamic forces. The partial differential equation of motion is then solved approximately, for panels with clamped or simply supported edges, using the Galerkin method. Plots of the critical dynamic pressure parameter as a function of the number of Galerkin modes are presented to demonstrate convergence properties of Galerkin's method. It is shown that a large number of modes may be necessary to give converged solutions. Curves of the critical dynamic pressure parameter as a function of flow angle are presented for various combinations of stiffness ratios and length-to-width ratios. Author

N66-32559# National Aero- and Astronautical Research Inst., Amsterdam (Holland).

SHEAR TESTS ON 24 S-T UNSTIFFENED AND STIFFENED WEBS WITH FLANGED HOLES, PART 2

M. Botman [1965] 140 p refs

(S-446) CFSTI: HC $3.00/MF $1.00

This report presents the results of shear tests on 32 specimens of unstiffened and stiffened webs with flanged holes, and is an extension of a previous test program. The same test methods were used. The buckling, yield, and ultimate allowable stresses are presented in the form of nondimensional diagrams. The initial effective modulus of rigidity is also determined. The results are compared with those of the previous tests and the agreement is generally good, except for the effective modulus of rigidity. R.N.A.

N66-32566# David Taylor Model Basin, Washington, D. C. Structural Mechanics Lab.

TRANSIENT RESPONSE OF A DAMPED MECHANICAL OSCILLATOR ATTACHED TO A SHOCK-WAVE-EXCITED, SUBMERGED CYLINDRICAL SHELL

Thomas L. Geers and Miguel C. Junger Mar. 1966 96 p refs

(DTMB-2142; AD-482236)

This report presents a simple analytical technique for investigating the response of a linear single degree-of-freedom mechanical oscillator mounted in a frame-stiffened cylindrical compartment of a shock-wave-excited submarine hull. Computations are performed to explore the dependence of peak oscillator response on oscillator fixed-base natural frequency, mass, and damping. It is found that damping is not a significant variable for lightly damped oscillators and that peak oscillator response can be correlated with reasonable accuracy in terms of two simple parameters. The general characteristics of experimental shock spectra measured in model tests and in tests on operational submarines are found to be predictable by means of two different mathematical models. Suggestions are made for further use of the analytical technique developed here, possibly in combination with experimental studies. Author

N66-32614*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

SUPERSONIC FLUTTER OF FLAT RECTANGULAR ORTHOTROPIC PANELS ELASTICALLY RESTRAINED AGAINST EDGE ROTATION

Larry L. Erickson Washington, NASA, Aug. 1966 36 p refs

(NASA-TN-D-3500) CFSTI: HC $2.00/MF $0.50 CSCL 20K

A theoretical solution is presented for the supersonic flutter characteristics of flat orthotropic panels subject to in-plane loads and various boundary conditions. The solution is valid for panels having nondeflecting edges which are simply supported, clamped, or elastically restrained against rotation. Numerical flutter results of the analysis are tabulated in terms of general parameters for simply supported and clamped panels and for three intermediate conditions of rotational edge restraint. From these parameters the dynamic pressure, frequency, and mode shape at flutter can be determined for large ranges of length-width ratio, stiffness ratio, and inplane stress. Author

N66-32628*# Ling-Temco-Vought, Inc., Dallas, Tex. Astronautics Div.

STRUCTURAL LOAD TEST RESULTS EVALUATION, ABL X-259 MOTOR LOADED AND UNLOADED CASE

J. R. Hyden 29 Apr. 1966 216 p refs *ftz* Rept.-23.276

(Contract NAS1-3899)

(NASA-CR-66151) CFSTI: HC $3.75/MF $1.25 CSCL 20K

Tests were conducted to determine the effect of internal strains from externally applied loads in the X-259 motor case, and to establish the structural failing load capabilities of the X-259 unloaded motor case. Loading the loaded motor case to 115% motor limits caused no damage to the motor case or the transition sections and, no internal damage to the case-bonding system or propellant grain. The results of the un-

loaded motor test showed that the motor case and transition sections can withstand higher loads than the ultimate design loads. Additional data and results from these tests are given and assessed. H.S.W.

N66-32664# Gt. Brit. Ministry of Aviation, London. Technical Information and Library Services.
ZONES OF STABILITY IN THE INDUCED VIBRATIONS OF SOME NON-LINEAR SYSTEMS [O ZONAKH USTOICHIVOSTI DLYA VYNUZHDENYKH KOLEBANII NEKOTORYKH NELINEINYK SISTEM]
E. G. Ivanov Jul. 1966 14 p refs Transl. into ENGLISH from Nauchn. Dokl. Vysshei Shkoly, Fiz.-Mat. Nauki (Moscow), no. 2, 1958 p 41-47
(TIL/T-5389) CFSTI: HC $1.00/MF $0.50

The present paper deals with the formation of Lyapunov's function for differential equations of the type $\ddot{X}+2\mu x+F(x)=R\cos \nu t$ and the determination of zones of stability for regimes of steady motion. By a stability zone we shall mean that portion of the plane in the coordinate system (ν, a) (where ν is the frequency and a is the amplitude of the vibration), the coordinates at each point of which satisfy the criterion of stability. Author

N66-32669*# Little (Arthur D.), Inc., Cambridge, Mass.
THERMAL SCALE MODELING TECHNIQUES FOR VOYAGER-TYPE SPACECRAFT
Frank Gabron 15 Jun. 1966 149 p refs Prepared for JPL
(Contracts NAS7-100; JPL-951417)
(NASA-CR-76942; C-66326-02) CFSTI: HC $3.00/MF $1.00 CSCL 22B

Techniques for designing one-half and one-fifth scale thermal models of a Voyager-type spacecraft and entry capsule are studied to determine the feasibility of testing reduced-scale models in a simulated space environment and, from test results, predicting the equilibrium temperatures of a full-scale prototype. A brief literature review pertaining to thermal similitude in spacecraft, a discussion of the theory of thermal similitude, and practical applications of two steady-state thermal scale modeling techniques are presented. Theoretical considerations show that either technique provides considerable freedom in the selection of model materials, and temperature scaling ratios when temperature fields are not three-dimensional in the prototype. The results indicate that the use of a 1/2 scale model, designed in accordance with the temperature preservation technique, is the best choice for predicting the temperatures of a Voyager-type spacecraft. Consideration is also given to modeling the spacecraft and its principle components as separate configurations and testing techniques for simulating the environment are discussed. A.G.O.

N66-32673*# Alabama Univ., University. Bureau of Engineering Research.
A STUDY OF THE STABILITY OF REINFORCED CYLINDRICAL AND CONICAL SHELLS SUBJECTED TO VARIOUS TYPES AND COMBINATIONS OF LOADS Final Report
William K. Rey Apr. 1966 388 p refs
(Contract NAS8-11155)
(NASA-CR-76846) CFSTI: HC $4.25/MF $2.00 CSCL 20K

The investigation consisted of studies in the following three areas: analytical studies of the stress distribution in conical shells of both linearly varying thickness and constant thickness subjected to various types of loads; a study of the feasibility of using small plastic cylinders in investigations of the stability of circular cylindrical shells subjected simultaneously to axial compressive loads and internal pressure; and, an experimental and analytical study of the stress distribution in integrally stiffened panels subjected to axial loads. Author

N66-32674*# Southwest Research Inst., San Antonio, Tex. Dept. of Mechanical Sciences.
A COMPARISON OF THEORETICAL AND EXPERIMENTAL PRESSURES AND FORCES ACTING ON A RING BAFFLE UNDER SLOSHING CONDITIONS Technical Report No. 10
Luis R. Garza May 1965 33 p refs
(Contract NAS8-1555; SwRI Proj. 02-1072)
(NASA-CR-76836) CFSTI: HC $2.00/MF $0.50 CSCL 20K

A comparison is presented on non-dimensionalized theoretical and experimental pressures and forces acting on a flat ring baffle under sloshing conditions. Comparisons are made for various baffle depths and for three values of tank excitation amplitudes. Force measurements for various perforated baffles are also presented. Author

33 THERMODYNAMICS AND COMBUSTION

Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also: 12 Fluid Mechanics; and 27 Propellants.

N66-31626# AVCO Corp., Wilmington, Mass. Research and Advanced Development Div.
THERMAL PROTECTION SYSTEMS. APPLICATION RESEARCH OF MATERIALS PROPERTIES AND STRUCTURAL CONCEPTS Final Report, 11 Jul. 1960-31 Dec. 1961
Henryk Hurwicz and Robert Mascola Wright-Patterson AFB, Ohio, AF Mater. Lab., Jan. 1965 709 p refs
(Contract AF 33(616)-7483)
(RAD-TR-62-14; ML-TDR-64-82; AD-611772) CFSTI: HC $9.80/MF $3.00

CONTENTS:

1. CURRENT KNOWLEDGE p 5-50
2. SYSTEMS ANALYSIS p 51-97
3. APPLICATION PERFORMANCE STUDIES p 99-163
4. SYSTEM AND MATERIAL SELECTION p 165-188
5. EXPERIMENTAL PROGRAM p 189-240
6. DESIGN AND DEVELOPMENT TECHNIQUES p 241-279

APPENDIXES:

7. THERMAL PROTECTION SYSTEM, "Q", TERMINOLOGY AND DEFINITIONS p 293-298 refs (See N66-31627 18-33)
8. BIBLIOGRAPHY OF THERMAL PROTECTION SYSTEMS FOR RE-ENTRY VEHICLES p 299-331
9. EXPERIMENTAL FACILITIES IN OPERATION FOR SIMULATION OF RE-ENTRY THERMAL ENVIRONMENT p 333-343
10. THERMAL PROTECTION OF SATELLITES WITH COLD WALL ABLATION p 345-382 refs (See N66-31628 18-33)
11. TRANSIENT THERMAL BEHAVIOR OF DECOMPOSING MATERIALS. PART I: GENERAL THEORY AND APPLICATION TO CONVECTIVE HEATING T. R. Munson and R. J. Spindler p 383-407 refs (See N66-31629 18-33)
12. A MODEL FOR ABLATION OF MATRICES IMPREGNATED WITH A PURE SUBSTANCE J. C. Boehringer p 409-417 (See N66-31630 18-33)

13. ELASTIC STRESS ANALYSIS AND BUCKLING OF SHELLS P. P. Radkowski p 419–452 refs (See N66-31631 18-32)

14. CORRELATION OF THERMAL PROTECTION SYSTEM PERFORMANCE BY DIMENSIONAL ANALYSIS TECHNIQUES p 453–457

15. THE STRUCTURAL STRENGTH OF SANDWICH CYLINDRICAL AND CONICAL SHELLS SUBJECTED TO ROTATIONALLY SYMMETRIC LOADING J. C. Serpico p 459–524 refs (See N66-31632 18-32)

16. A STUDY OF CREEP COLLAPSE OF A LONG CIRCULAR CYLINDRICAL SHELL UNDER VARIOUS DISTRIBUTED FORCE SYSTEMS J. C. Serpico p 525-550 refs (See N66-31633 18-33)

17. MULTI-DIMENSIONAL HEAT FLOW AND ABLATION DURING RE-ENTRY H. Hurwicz and T. Brady (Dian Labs.) p 551–577 refs (See N66-31634 18-33)

18. WORKING GRAPHS FOR PARAMETRIC STUDIES p 579–598

19. SAMPLE PROBLEMS USING AN APPROXIMATE METHOD FOR DESIGN OF THERMAL PROTECTION SYSTEMS FOR GLIDE RE-ENTRY VEHICLES OR SYSTEMS IN WHICH THE PREDOMINANT THERMAL MECHANISM IS SURFACE RADIATION AND OR ABLATION p 599–631

20. SOLUTION OF LAMINAR COMPRESSIBLE BOUNDARY LAYER WITH DISCRETE INJECTION (FOR AIR IN CHEMICAL EQUILIBRIUM) A. Pallone p 633–639 ref (See N66-31635 18-12)

21. THE STAGNATION POINT FLOW OF NON-EQUILIBRIUM AIR, WITH AND WITHOUT INJECTION A. Pallone p 641–663 refs (See N66-31636 18-12)

N66-31627# AVCO Corp., Wilmington, Mass. Research and Advanced Development Div.

THERMAL PROTECTION SYSTEM, "Q", TERMINOLOGY AND DEFINITIONS

In its Thermal Protect. Systems Jan. 1965 p 293–298 refs (See N66-31626 18-33) CFSTI: HC $9.80/MF $3.00

The "Q" concept for radiation and radiation ablation systems is defined as heat absorbed per unit mass of a steady-state ablating material. Equivalent values of effective transient heats of ablation are obtained by accurate conductivity calculations together with the specific aerodynamic inputs and material properties of the investigated systems. G.G.

N66-31628# AVCO Corp., Wilmington, Mass. Research and Advanced Development Div.

THERMAL PROTECTION OF SATELLITES WITH COLD WALL ABLATION

In its Thermal Protect. Systems Jan. 1965 p 345–382 refs (See N66-31626 18-33) CFSTI: HC $9.80/MF $3.00 (Contracts AF 04(647)-347; AF 33(616)-7483)

Evaluation of principal material parameters affecting the heat-shield design for reentering satellites led to the conclusion that low temperature ablators should be utilized and that their thermal conductivities and heats of ablation should be respectively, minimized and maximized. In addition to thermodynamic criteria, fabrication problems and mechanical strength have to be considered in a final analysis. As most significant parameters for satellite capsule heat shield design evolved: surface temperature, thermal conductivity, and the blowing factor for materials; the structural temperature allowable for the design; and the aerodynamic reentry angle. It was concluded that the development of lower temperature (700°F) ablators, or materials with significantly lower conductivities (k 0.025 Btu/hr-ft-° F), is needed. G.G.

N66-31629# AVCO Corp., Wilmington, Mass. Research and Advanced Development Div.

TRANSIENT THERMAL BEHAVIOR OF DECOMPOSING MATERIALS. PART I: GENERAL THEORY AND APPLICATION TO CONVECTIVE HEATING

T. R. Munson and R. J. Spindler *In its* Thermal Protect. Systems Jan. 1965 p 383–407 refs (See N66-31626 18-33) (Contracts AF 04(647)-305; AF 04(647)-258; AF 04(647)-806) CFSTI: HC $9.80/MF $3.00

A mathematical model has been presented for the transient behavior of materials which undergo thermal decomposition in depth. The model considers energy transfer by conduction, convection, and radiation and is applicable to situations involving arbitrarily time varying heat inputs of both a convective and a radiative nature. Application of the model to several materials subjected to convective heating has been made by means of both analogue and digital computers. The results are compared with experiment and shown to provide satisfactory agreement in certain cases which are far removed from steady state. It is concluded on the basis of the agreement between theory and experiment that the assumptions made in developing the model are justifiable at least for the materials considered. Author

N66-31630# AVCO Corp., Wilmington, Mass. Research and Advanced Development Div.

A MODEL FOR ABLATION OF MATRICES IMPREGNATED WITH A PURE SUBSTANCE

J. C. Boehringer *In its* Thermal Protect. Systems Jan. 1965 p 409–417 (See N66-31626 18-33) CFSTI: HC $9.80/MF $3.00

The problem under consideration concerns a model for heat transfer calculations of a composite material, part of which vaporizes at a lower temperature leaving a porous matrix that is also allowed to melt and vaporize into the boundary layer. The solution of the problem is related to the diffusion theory. Development on this work was ceased after its formulation because it is believed that similar problems can be solved by Avco RAD's programmed plastic ablation model. For this reason no numerical results were obtained. The work did, however, serve to provide some insight into the ablation process in such materials. Author

N66-31633# AVCO Corp., Wilmington, Mass. Research and Advanced Development Div.

A STUDY OF CREEP COLLAPSE OF A LONG CIRCULAR CYLINDRICAL SHELL UNDER VARIOUS DISTRIBUTED FORCE SYSTEMS

Joseph C. Serpico *In its* Thermal Protect. Systems Jan. 1965 p 525–550 refs (See N66-31626 18-33) CFSTI: HC $9.80/MF $3.00

An analysis is presented for determining the collapse of circular rings and long cylinders subjected to primary and secondary creep conditions at elevated temperatures. The types of loading considered for the present investigation are dead loading and hydrostatic pressure-type forces. The method of solution is based on an application of the variational theorem for creep described in reference X-1 with some additional terms being introduced for the pressure-type loading case. The general results are reduced to a relatively simple form for the theoretical predictions of collapse time and are graphically illustrated for a typical sample material. Author

N66-31634# AVCO Corp., Wilmington, Mass. Research and Advanced Development Div.

MULTI-DIMENSIONAL HEAT FLOW AND ABLATION DURING RE-ENTRY

H. Hurwicz and T. Brady (Dian Labs., Inc.) *In its* Thermal Protect. Systems Jan. 1965 p 551-577 refs (See N66-31626 18-33)
(Contracts AF 33(616)-7483; AF 04(647)-258; AF 04(647)-305) CFSTI: HC $9.80/MF $3.00

Physical conditions (non-uniformities) and actual re-entry applications resulting in multi-dimensional heat flow and ablation are discussed. Mathematical formulation of problems arising in prediction of temperature response and surface recession is given for many commonly encountered multi-dimensional cases. Methods of programming of such problems for the electronic analogue computations are developed. Savings in equipment and computing ease are achieved by either appropriate mathematical transformations, or the complexity of the problem is reduced by physically justified simplified assumptions. The case of the wing leading edge of a re-entry glider is analyzed in detail while the calculated results were shown in the body of main report. Author

N66-31671*# Argonne National Lab., Ill.
PROCEEDINGS OF THE CONFERENCE ON APPLICATION OF HIGH TEMPERATURE INSTRUMENTATION TO LIQUID-METAL EXPERIMENTS
[1965] 667 p refs Conf. held 28-29 Sep. 1965 Sponsored jointly by NASA and AEC
(Contract W-31-109-ENG-38)
(NASA-CR-76450; ANL-7100) CFSTI: HC $6.75/MF $3.25 CSCL 20M

Conference papers on thermodynamics and heat transfer measurements, quality and void fraction measurements, bearing film measurements, liquid level and impurity measurements, and heat transfer are presented. For individual titles see N66-31672-N66-31700.

N66-31672*# Argonne National Lab., Ill.
HEATING TECHNIQUES FOR LIQUID METAL LOOPS
Robert E. Holtz *In its* Proc. of the Conf. on Appl. of High Temp. Instrumentation to Liquid-Metal Expt. [1965] p 9-22 refs (See N66-31671 18-33) CFSTI: HC $6.75/MF $3.25

Techniques for studying the boiling and fluid flow behavior of alkali metals were investigated. A thermal radiation heat transfer loop was constructed primarily from stainless steel tubing and used sodium potassium alloy as the heat transfer fluid. Fairly high and uniform heat fluxes to a high temperature liquid metal were considered feasible. Data obtained were found to agree with published results. The basic electron bombardment heating system, for studying heat transfer in annular flow, consists of two concentric tubes with heat supplied by a thoriated tungsten cathode, applied to the inside surface of the inner tube while liquid metal flows in the annulus between the tubes. Voltages ranging up to 20,000 volts and currents ranging up to one ampere were obtained. It was found that the sodium surrounding the anode was sufficiently subcooled so that no boiling occurred. Descriptions and schematics of both systems are included. The designing of a niobium-1% zirconium loop heater, to investigate the heat transfer and two-phase flow characteristics of boiling sodium up to a temperature of 2100°F, is also reported. N.E.N.

N66-31673*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
ELECTRICAL HEATER FOR LIQUID METALS AT ELEVATED TEMPERATURES
Lance G. Hays *In* Argonne Natl. Lab. Proc. of the Conf. on Appl. of High Temp. Instrumentation to Liquid-Metal Expt. [1965] p 23-44 refs (See N66-31671 18-33) CFSTI: HC $6.75/MF $3.25
(Contract NAS7-100)

Analysis and preliminary sizing of the five megawatt conduction heater, and testing of geometrically similar heater elements for a liquid metal MHD spacecraft power concept are discussed. The relationship between center conductor temperature, geometry, and electrical characteristics as a function of the allowable insulator field strength and material properties was examined. The initial test geometry was fabricated and tested in lithium which had a tantalum center conductor of swaged alumina insulation and an Nb-1%Zr sheath. The fabrication is described and a schematic is presented. The initial test procedures and results are discussed. It was felt that the tests demonstrated the basic feasibility of using swaged conduction heaters at elevated temperatures with field strengths of up to 3 volts/mil across the ceramics. Post-test examination of the heater revealed slight reactions between the alumina and tantalum and the boron nitride and Nb-Zr in the end weldment region. N.E.N.

N66-31674*# Aerojet-General Nucleonics, San Ramon, Calif.
FLOW INSTRUMENTATION AND OPERATING EXPERIENCE IN A CONDENSING ALKALI METALS TEST LOOP
C. R. Fisher and J. H. Moskowitz, Jr. *In* Argonne Natl. Lab. Proc. of the Conf. on Appl. of High Temp. Instrumentation to Liquid-Metal Expt. [1965] p 45-52 refs (See N66-31671 18-33) CFSTI: HC $6.75/MF $3.25
(Contract AT(04-3)-368)
(AGN-TP-157)

The condensing heat transfer characteristics of rubidium and cesium were investigated for both horizontal and vertical flow in a straight, round duct. A schematic of the test apparatus is shown and the test procedures are described. An emf across the magnetic flowmeter cell, used to measure the flow rate of the liquid metal, was observed during the calibration of the meter when there was no flow in the loop, and this data is graphed. When only the liquid phase flowed in the loop, the voltage-current relationship for the dryer-superheated indicated that the stainless steel tube wall and the liquid metal shared the electrical current in inverse proportion to the calculated resistance of each material. A large difference in the time required for the magnetic flowmeters and ac conduction pumps to reach asymptotic performance for stainless steel and for refractory metal loops was found. These observations are discussed, and preliminary results of the condensing heat transfer tests are presented. N.E.N.

N66-31675*# General Electric Co., Cincinnati, Ohio. Space Power and Propulsion Section
HEAT TRANSFER AND PRESSURE DROP MEASUREMENTS FOR HIGH TEMPERATURE BOILING POTASSIUM IN FORCED CONVECTION
J. A. Bond, J. R. Peterson, and F. E. Tippets *In* Argonne Natl. Lab. Proc. of the Conf. on Appl. of High Temp. Instrumentation to Liquid-Metal Expt. [1965] p 53-96 refs (See N66-31671 18-33) CFSTI: HC $6.75/MF $3.25
(Contract NAS3-2528)

Instrumentation and measurement techniques used for experiments with forced convection boiling potassium in a sodium-heated Haynes-25 alloy test facility at potassium temperatures to 1750°F and in a radiant-heated Nb-1Zr facility at temperatures to 2100°F are described. Some of the heat transfer and pressure drop results obtained are presented. The heat transfer data presented include measurements of heat transfer coefficients in the nucleate boiling and transition boiling regimes and measurements of onset of critical heat flux conditions. Author

N66-31676*# General Electric Co., Cincinnati, Ohio. Space Power and Propulsion Section.
MEASUREMENTS OF FORCED CONVECTION CONDENSING POTASSIUM HEAT TRANSFER
S. G. Sawochka *In* Argonne Natl. Lab. Proc. of the Conf. on Appl. of High Temp. Instrumentation to Liquid-Metal Expt. [1965] p 97–126 refs (See N66-31671 18-33) CFSTI: HC $6.75/MF $3.25
(Contract NAS3-2528)

A discussion of temperature and flow rate measuring techniques, which have allowed the determination of heat transfer and pressure change data for the forced convection condensation of potassium, is presented. Intercalibration of the condensing test section thermocouples is discussed, and representative tube wall radial temperature profiles and potassium axial temperature profiles are presented. Author

N66-31679*# Argonne National Lab., Ill.
FORCED CONVECTION BOILING SODIUM STUDIES AT LOW PRESSURE
J. B. Heineman *In its* Proc. of the Conf. on Appl. of High Temp. Instrumentation to Liquid-Metal Expt. [1965] p 189–194 (See N66-31671 18-33) CFSTI: HC $6.75/MF $3.25

The two-phase flow of forced convection boiling sodium up to approximately atmospheric and 2100°F was investigated. The range of liquid superheats obtained prior to the initiation of boiling was found to be lower than published results. Within the range of variables tested, there was no discernible flow rate effect. Stability was achieved in the pressure range greater than 7 psia, and void fraction data were obtained in the 7–17 psia range. The electromagnetic flowmeter method was considered adequate for measuring the quantity of vertical upflow. The flowmeter method yielded values consistently lower than the gamma attenuation technique, and correction factors are discussed. The apparatus is described, and the results are presented in graph form. N.E.N.

N66-31680*# TRW Systems, Redondo Beach, Calif.
X-RAY MEASUREMENT OF VOID DYNAMICS IN BOILING LIQUID METALS
L. B. Wentz, L. G. Neal, and R. W. Wright *In* Argonne Natl. Lab. Proc. of the Conf. on Appl. of High Temp. Instrumentation to Liquid-Metal Expt. [1965] p 195–215 refs (See N66-31671 18-33) CFSTI: HC $6.75/MF $3.25

The use of X-ray attentuation for vapor–void measurements in liquid metal systems and with a time response of the order of one millisecond is reported. Considerations for rectangular and tubular channels, void fraction distributions, accuracy, and space and time resolutions are discussed. Experimental results showed that changes of void fraction in liquid metal boiling occur in milliseconds. Sodium and potassium were found to have about the same X-ray attenuation coefficients as water over a wide range of energies, and differences are mainly in the boiling behavior. Potassium is more opaque to X-rays in the photoelectric region than water and sodium, but it becomes very similar to them above 100 keV. N.E.N.

N66-31693*# Argonne National Lab., Ill.
A METHOD FOR THE DETERMINATION OF LOCAL HEAT FLUXES IN LIQUID METAL HEAT EXCHANGERS
Ralph P. Stein *In its* Proc. of the Conf. on Appl. of High Temp. Instrumentation to Liquid-Metal Expt. [1965] p 483–498 refs (See N66-31671 18-33) CFSTI: HC $6.75/MF $3.25

A new method is presented for the determination of local heat fluxes and fully developed local overall heat transfer coefficients in liquid metal or laminar flow double-pipe heat exchangers. The method uses measurements of outer wall temperature distributions and inlet and outlet fluid temperatures. Possible application to liquid cooled or heated condensers or boilers is discussed. Author

N66-31694*# Brookhaven National Lab., Upton, N. Y.
EXISTENCE OF NON-EQUILIBRIUM, INVERSE TEMPERATURE PROFILE IN BOILING TWO-PHASE FLOW
John C. Chen *In* Argonne Natl. Lab. Proc. of the Conf. on Appl. of High Temp. Instrumentation to Liquid-Metal Expt. [1965] p 499–512 refs (See N66-31671 18-33) CFSTI: HC $6.75/MF $3.25

An experiment with boiling two-phase flow of potassium, which indicates the existence of an inverse temperature profile in the two-phase fluid is described, and a theoretical explanation is presented. Wall and fluid temperatures were measured for vertical, axial flow of potassium vapor and liquid through a boiling section, and the results are graphed. It was suggested that the inverse phenomena can be caused by a nonequilibrium condition in the vapor core which is accentuated by high pressure drop, a steep vapor temperature–pressure curve, and high velocity–high slip flow. N.E.N.

N66-31695*# Oak Ridge National Lab., Tenn.
SUPERHEAT WITH BOILING ALKALI METALS
J. A. Edwards and H. W. Hoffmann *In* Argonne Natl. Lab. Proc. of the Conf. on Appl. of High Temp. Instrumentation to Liquid-Metal Expt. [1965] p 515–534 refs (See N66-31671 18-33) CFSTI: HC $6.75/MF $3.25

The results of experiments in a natural-circulation loop to establish the magnitude of the superheat associated with alkali-metal boiling are reported. For potassium boiling on an as-received surface, the superheat measured ranged from 500°F to a saturation temperature of 1500°F down to 230°F at T_{sat}=1770°F. Wall temperature oscillations were of the order of 170 to 300°F at a frequency of 1.5 cycles/min. Significant reductions in the magnitude of the superheat and, hence, in the amplitude of the wall temperature oscillations were affected by modifying the boiler surface. The superheat with potassium was reduced about fortyfold below the value obtained on the as-received surface. A porous surface was less effective than the surface with discrete holes but still showed appreciable reductions in the superheat. Similar results were obtained with sodium. The superheat data for both potassium and sodium correlate reasonably with predictions based on a model involving a spherical vapor bubble in thermal equilibrium within a liquid pool of uniform temperature. Author

N66-31696*# Oak Ridge National Lab., Tenn.
PRESSURE DROP WITH FORCED-CONVECTION BOILING OF POTASSIUM
R. P. Wichner and H. W. Hoffman *In* Argonne Natl. Lab. Proc. of the Conf. on Appl. of High Temp. Instrumentation to Liquid-Metal Expt. [1965] p 535–547 refs (See N66-31671 18-33) CFSTI: HC $6.75/MF $3.25

The results are given for the pressure drop with boiling potassium in forced convection flow through a vertical, circular tube. The data, which comprise a single series of measurements, were obtained in a 6-ft long×0.270-in.-ID tube having pressure taps at 1-ft spacing over the final 4 ft of the channel. The pressure measurement system and its deficiencies are discussed; the primary difficulty appears to be aging of the diaphragms in the pressure transmitters over long exposure times at high temperatures. The pressure distribution along the boiler was estimated; the calculated exit pressure compared favorably with the measured values. Author

N66-31697*# Atomics International, Canoga Park, Calif.
SODIUM BOILING HEAT TRANSFER AND HYDRODYNAMICS
Henry Lurie *In* Argonne Natl. Lab. Proc. of the Conf. on Appl. of High Temp. Instrumentation to Liquid-Metal Expt. [1965] p 549–571 refs (See N66-31671 18-33) CFSTI: HC $6.75/MF $3.25
(Contract AT(11-1)-GEN-8)

Results of experiments on the steady state pool boiling critical heat flux of saturated sodium as a function of pressure, and on the forced convection boiling heat transfer characteristics and critical heat flux of sodium as function of pressure, flow rate, and subcooling or quality are reported. Also presented are the steady state two-phase pressure drop and void fraction results for the upflow of sodium in an unheated annulus. The pool boiling experiments are reviewed, and a graph of the critical heat flux for saturated pool boiling is included. Details of the forced convection loop, used for the forced flow heat transfer and hydrodynamic tests, and a schematic of the apparatus are presented. The experiments are described, and the results are graphed. It was concluded that the previous reported variation of the critical heat flux of sodium with pressure is confirmed, and extrapolation to actual reactor conditions is possible. Useful critical heat flux, pressure drop, and void fraction correlations were obtained. N.E.N.

N66-31698*# Aerojet-General Nucleonics, San Ramon, Calif.
RECENT DEVELOPMENTS IN HEAT TRANSFER AND DEVELOPMENT OF THE MERCURY BOILER FOR THE SNAP-8 SYSTEM
A. J. Sellers (Aerojet-Gen., Azusa, Calif.), G. M. Thur, (NASA, Lewis Res. Center), and M. K. Wong *In* Argonne Natl. Lab. Proc. of the Conf. on Appl. of High Temp. Instrumentation to Liquid-Metal Expt. [1965] p 573–632 refs (See N66-31671 18-33) CFSTI: HC $6.75/MF $3.25
(Contract NAS5-417)

The thermal and dynamic performance characteristics of different once-through boiler plug-insert geometries were investigated. The test loop, designed to simulate the SNAP-8 dynamic cycle conditions, is a three-loop system consisting of a heated primary circulation NaK loop, coupled through a simulated mercury boiler Rankine cycle loop which in turn rejects its heat through the condenser to an air cooled circulating NaK loop. The boiler and loops, and the temperature, pressure, and flow measurements are described. Schematics are presented, and the operation is discussed. The results are presented in graph form. Among the conclusions are: The preheat section plug insert provided significant improvement in the boiler conditioning effect and stable boiler performance. The boiler conditioning time is apparently dependent upon the cleanliness of the internal wall surface of the mercury flow passage. The most effective boiling heat transfer was obtained from extended length plug insert geometries where the plug insert end-point vapor quality and vapor phase velocity were up to 80% and 180 ft/sec. N.E.N.

N66-31699*# TRW Equipment Labs., Cleveland, Ohio.
X-RAY MOVIE FILM REPORT OF FLOW PATTERNS IN A ONCE-THROUGH FORCED CIRCULATION NaK HEATED MERCURY BOILER
R. J. Ziobro *In* Argonne Natl. Lab. Proc. of the Conf. on Appl. of High Temp. Instrumentation to Liquid-Metal Expt. [1965] p 633–640 (See N66-31671 18-33) CFSTI: HC $6.75/MF $3.25

The films, which offered a visual insight into the two-phase flow liquid metal boiling process at temperatures and pressures where glass equipment cannot be used, is reviewed. Brief descriptions are included for various parts of the test sections. Boiler performance was shown in the conditioned state and in various degrees of deconditioning. It is mentioned that there is a slug flow pattern in the decondition state, and that this flow regime has been defined mathematically in a form suitable for boiler design analysis and performance evaluation. N.E.N.

N66-31734# Library of Congress, Washington, D. C. Aerospace Technology Div.
CONVECTIVE HEAT AND MASS TRANSFER IN THE COMBUSTION OF CHEMICALLY ACTIVE SUBSTANCES IN THE BOUNDARY LAYER ON A POROUS SURFACE [KONVEKTIVNYY TEPLO- I MASSOOBMEN PRI GORENII KHIMICHESKI AKTIVNYKH VESHCHESTV NA PORISTOY POVERKHNOSTI V POGRANICHNOM SLOYE] Surveys of Foreign Scientific and Technical Literature
Bartholomew Poplawski 17 Mar. 1966 18 p refs Transl. into ENGLISH from Teplo- i Massoobmen Tel S Okruzhayushchey Gazovoy Sredoy (Minsk), 1965 p 168–175
(ATD-66-26)

The solution of a number of problems involved in the creation of new equipment requires exploring methods of thermal protection of various construction materials used under extreme heat loads. At present, special attention is being given to one of the methods of thermal protection of surfaces against high-temperature flows. This method consists in the feeding of the coolant through a porous surface, and then the main flow, which flows over the surface, reacts with the coolant. The effect of combustion on the heat and mass transfer process during the injection of gas or liquid has been studied both in the laminar and turbulent boundary layers. After elaborating a little more thoroughly on the above data, the author analyzes and discusses the 15 articles given in the Bibliography. These articles, for the most part, are concerned with theoretic investigation of friction and heat transfer in a compressible turbulent boundary layer, with chemical reactions caused by the introduction of a foreign substance. A list of designations is included with the article. Author

N66-31858*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EXPLORATORY INVESTIGATION OF THE EFFECT OF NYLON GRAIN SIZE ON ABLATION OF PHENOLIC NYLON
Gerald D. Walberg and Roger K. Crouch Washington, NASA, Aug. 1966 40 p refs
(NASA-TN-D-3465) CFSTI: HC $2.00/MF $0.50 CSCL 20M

An exploratory investigation of the effect of nylon grain size on the ablation of phenolic nylon has been carried out. Ablation models which differed only with respect to nylon grain size were tested in air and in nitrogen at stream stagnation temperatures from 2300°R to 3600°R (1278°K to 2000°K), a stream stagnation pressure of approximately 100 psia (0.69 MN/m^2), and a Mach number of approximately 2. Two series of models were tested. The models in the first series contained nylon particles having dimensions larger than 0.0098 inch (0.25 mm) and those in the second series contained nylon particles having dimensions smaller than 0.0017 inch (0.043 mm). The results obtained from these tests showed that the mechanical strength of the char layers produced and the resistance of these chars to removal by aerodynamic and chemical mechanisms were greater for the small-grain material than for the large-grain material. Author

N66-31925# Institut Franco-Allemand de Recherches, St. Louis (France).
COMPARISON OF TEMPERATURE DISTRIBUTIONS AND OF COMBUSTION SPEEDS WITH DIFFERENT INCENDIARY SUBSTANCES [VERGLEICH DER TEMPERATURVERTEILUNG UND ABBRANDGESCHWINDIGKEIT VON BRAND STOFFEN]
H. W. Koch and F. Popperl 12 Oct. 1965 36 p refs In GERMAN
(T-37/65) CFSTI: HC $2.00/HF $0.50

Napalm and phosphor-magnesium compounds, intended for military use, are analyzed as to chemical composition and incendiary characteristics. Test arrangements for determining temperature rates in various environments are explained. Burning time as a function of amount, and spatial extension of the flame, are also measured. Results of the measurements are presented in tables and diagrams and are compared. Transl. by K.W.

N66-31939*# Pratt and Whitney Aircraft, East Hartford, Conn.
VAPOR-CHAMBER FIN STUDIES Third Quarterly Report, 1 Dec. 1965–28 Feb. 1966
L. S. Langston, A. Sherman, and B. H. Hilton Apr. 1966 131 p refs
(Contract NAS3-7622)
(NASA-CR-54989; PNA-2818) CFSTI: HC $3.00/MF $1.00 CSCL 20M

Wicking ability, permeability, and boiling characteristics of various porous metallic materials were evaluated, and vapor-chamber fins using materials found to have the most promising capillary properties were tested. Porosity, pore size distribution, and free-flow area ratio of porous metal samples were determined. Wicking rise tests were conducted using water and Freon 113. The equilibrium height of the water front was found to vary from 2.10 in. in a sintered screen sample to 21.0 in. in a sintered powder sample. Equilibrium heights with Freon 113 were lower, due primarily to its lower surface tension. The wick friction factor was measured in permeability tests utilizing water. This factor was found to be independent of flow rate for low flow rates, and independent of liquid temperature. The boiling heat transfer characteristics of a flat plate, two sintered screen samples, and a sintered powder sample were measured. All the porous samples had lower heat transfer coefficients than the flat plate. This was attributed to the premature occurrence of film boiling, caused by the entrapment of vapor bubbles in the wick matrix. Author

N66-31983# Harvard Univ., Cambridge, Mass. Engineering Sciences Lab.
ON THE STEADY KROOK KINETIC EQUATION: II
Donald G. Anderson Apr. 1966 46 p refs
(Grant NSF GK-65)
(TR-27)

Numerically exact solutions to problems of heat transfer through a rarefied gas confined between concentric circular cylinders and spheres are obtained. The problems were formulated as systems of nonlinear integral equations to the steady Krook kinetic equation. Governing equations, numerical procedure, and selected samples of the results are presented. Condensed edited tables of the numerical solutions and number density, kinetic temperature, and heat flux plots are also included. A.O.

N66-32143*# Princeton Univ., N. J.
ON THE THERMODYNAMICS AND APPROXIMATION THEORY OF VISCOELASTIC MATERIALS
D. C. Leigh (Kentucky Univ.) [1966] 18 p refs Submitted for Publication
(Grant NSG-664)
(NASA-CR-76559) CFSTI: HC $1.00/MF $0.50 CSCL 20M

The assumption of fading memory is applied to a class of viscoelastic materials, and the thermodynamic properties and the approximation method is investigated for fluids with fading memory. A perfect fluid zero-order approximation is made, and classical results obtained. For the first-order approximation, corresponding to the Newtonian fluid, the constitutive equations differ from the traditional ones because of the possibility of certain additional terms; restrictions are obtained on the new coefficients as well as the classical restrictions on the coefficients. Restrictions on the material coefficients are also listed for the second-order approximation. R.H.

N66-32185# Bureau of Mines, Pittsburgh, Pa. Explosives Research Center.
AUTOIGNITION OF HYDROCARBON JET FUEL
Joseph M. Kuchta, A. Bartkowiak, and M. G. Zabetakis 1965 33 p refs Sponsored by AF
(BM-RI-6654)

Experimental data are presented on the autoignition temperature (AIT) characteristics of the hydrocarbon jet fuel, JP-6, in various oxygen–nitrogen atmospheres under conditions of constant volume and constant pressure. AIT's of this fuel in air varied little with fuel injection pressure but increased greatly with decreasing fuel content at low fuel–air ratios. They also increased with decreasing oxygen content of the fuel vapor–oxidant atmosphere. Consistent with thermal ignition theory, the ignition temperatures increased with decreasing initial pressure, ignition delay, and vessel radius; expressions are given which define the observed variation of AIT with these variables for JP-6 fuel vapor–air mixtures. The significance of autoignition temperature data obtained using various ignition criteria is discussed to show the usefulness of such data in evaluating fire and explosion hazards. In addition, data are presented on the extent of oxidation that occurs prior to autoignition of this fuel in air at various temperatures. Author

N66-32218# Tennessee Univ., Knoxville.
AN INVESTIGATION OF ONE AND TWO DIMENSIONAL TRANSIENT HEATING OF A BLUNT CONE RE-ENTERING THE EARTH'S ATMOSPHERE
Thaddeus Howes Sandford (M.S. Thesis) Mar. 1966 145 p refs
(Contract AF 33(608)-1281)
(AD-481950)

In the one-dimensional case, solutions for the surface temperature history were found in closed form for the limiting cases of a thin and semi-infinite wall thickness. The range of validity of each of the limiting cases was given in terms of a dimensionless grouping of vehicle and flight path constants. For the one-dimensional case, the solution for the surface temperature history of an arbitrary wall thickness was obtained in integral form. In the two-dimensional case, solutions for the surface temperature history were obtained in integral form for a hemisphere and a cone, each subjected to a laminar, distributed, time-varying heat flux. In the period of re-entry prior to the point of maximum heat flux, the surface temperature was shown to vary as the square root of the altitude parameter xi, for both cases of one and two-dimensional heat conduction. TAB

N66-32320# Institut Franco-Allemand de Recherches, St. Louis (France).
TEMPERATURE AUGMENTATIONS AND NATURE OF REACTIONS PRODUCED BY HIGH VELOCITY SHOOTING OF SPHERES IN A HYDROGEN–AIR MIXTURE [TEMPERATURERHOHUNGEN UND REAKTIONSVERLAUF BEI HOCHGESCHWINDIGKEITSSCHUESSEN MIT KUGELN IN KUGELN IN WASSERSTOFF–LUFT-GEMISCHE]
H. Behrens 22 Apr. 1965 25 p refs In GERMAN
(Contract T-553-J-206)
(ISL-T-23/65) CFSTI: HC $1.00/MF $0.50

The temperature calculation of the gases in the combustion canal, based on the progression of the aft wave, has been simplified by disregarding the reflection of the wave. By means of a projectile fired at Mach number M=7.1 it is demonstrated that the temperature increase remaining in the combustion gas can be thermodynamically determined at high Mach numbers, assuming that the mixture heated by the shock wave reacts close to the balance in the shock zone, and that the gas mixture in the expansion flow becomes frozen near the sonic boundary. Reactions and circumstances affecting the full utilization of propellants in flows with high initial temperature and subsequent expansion are discussed. Transl. by K.W.

N66-32362# Los Alamos Scientific Lab., N. Mex.
CALCULATIONS OF THE THERMAL PROPERTIES OF HYDROGEN
B. B. Fisher 20 Apr. 1966 49 p refs
(Contract W-7405-ENG-36)
(LA-3364) CFSTI: HC $3.00/MF $0.50

The theory and equations to compute the high-temperature, thermodynamic properties for real hydrogen gas are described. They were also developed for use in a computer program. The equations are for the thermodynamic properties of dissociating hydrogen for temperatures from 600 to 5000°K and for pressures from near zero to 340 atmospheres. The property equations were obtained through an equation of state which extends to the third virial coefficients. The most important virial coefficients, those of molecular hydrogen, were based upon new high-temperature hydrogen viscosity measurements. The coefficient of viscosity and the coefficient of thermal conductivity were also calculated for the same set of conditions. Author (NSA)

N66-32378# Kernforschungsanlage, Juelich (West Germany).
CONSTRUCTION OF APPARATUS FOR DETERMINATION OF THERMAL CONDUCTIVITY OF COAL STONES IN GAS AT PRESSURES IN THE 0–15 ATMOSPHERE RANGE AND AT TEMPERATURES UP TO 250°C [BAU EINER APPARATUR ZUR BESTIMMUNG DER WAERMELEITFAEHIGKEIT VON HARTKOHLE (KOHLESTEIN) UNTER GASATMOSPHAERE IN DRUCKBEREICH VON 0–15 ATUE UND BEI TEMPERATUREN BIS 250°C]
J. Langen and R. Hecker Brussels, EURATOM, May 1966 25 p refs In GERMAN; ENGLISH summary
(Contract EURATOM-003-63-IRGAD)
(THTR-5; EUR-2775-d) CFSTI: HC $1.00/MF $0.50

It is stated that coal stones are of interest as building materials for high temperature reactors. This study investigated the thermal conductivity of this material. Various stationary and dynamic methods of determination were examined and a procedure using thermocouples to measure radial heat flow was selected. The formula used to calculate the thermal conductivity is provided, and the data obtained are assessed. H.S.W.

N66-32423# Bureau of Mines, Pittsburgh, Pa.
THERMAL PHENOMENA DURING IGNITION OF A HEATED DUST DISPERSION
John Nagy and Donald J. Surincik 1966 33 p refs
(BM-RI-6811)

Thermal theories explaining combustion of gases to correlate parameters affecting ignition of dust dispersions were adapted. The dust dispersions were ignited in a Godbert–Greenwald furnace at atmospheric pressure. Ignition temperature and the concentrations of fuel, admixed inert powder, and atmospheric oxygen were related mathematically. Values for these parameters obtained in laboratory experiments for cornstarch agreed with theory. The developed equation permits extrapolation; the predicted upper ignition limits correspond with limited experimental data from laboratory and large-scale tests. Explanation of the effect of fineness of dust on ignition parameters is attempted by introducing a surface-area constant to modify the activation energy. Arguments are presented to show that the ignition process is a solid–gas phase reaction rather than an ignition of prevolatilized gases. Author

N66-32438*# Illinois Univ., Urbana.
THEORETICAL STUDY OF RADIANT HEAT EXCHANGE FOR NON-GRAY NON-DIFFUSE SURFACES IN A SPACE ENVIRONMENT Semiannual Status Report No. 3, Feb.–Jul. 1966
R. G. Hering, A. F. Houchens, and T. F. Smith 1 Jul. 1966 37 p refs
(Grant NGR-14-005-036)
(NASA-CR-76764) CFSTI: HC $2.00/MF $0.50 CSCL 20M

Studies on assessing the importance of such real surface radiating characteristics as non-diffuseness and non-grayness on the radiant heat transfer of surfaces in a space environment are reported. An analysis for equilibrium temperatures using gray diffuse theory is presented which reduces the evaluation of local radiant heat loss or temperature to solution of two integral equations. Criteria are being developed for the use of certain directional reflectance relations by application of Maxwell's equations to the reflection of an electromagnetic wave. Research on the radiation properties for rough surfaces of conducting materials is briefly discussed. Analytical data on radiative heat exchange between specularly reflecting surfaces with direction-dependent properties are also included. Numerical results for local and total heat loss are presented for a range of included angles, plate temperature ratios, and hemispherical emissivity values. A.G.O.

N66-32452# Oak Ridge National Lab., Tenn.
THERMAL CONDUCTIVITY OF MAGNESIA, ALUMINA, AND ZIRCONIA POWDERS IN AIR AT ATMOSPHERIC PRESSURE FROM 200°F TO 1500°F
H. W. Godbee (Ph.D. Thesis Ga. Inst. of Tech.) Apr. 1966 201 p refs
(Contract W-7405-ENG-26)
(ORNL-3510) CFSTI: HC $6.00/MF $1.25

Radial heat flow was used to measure thermal conductivity for extensively characterized magnesia, alumina, and zirconia powders in dry air at atmospheric pressure from about 200° to 1500° F. Particle size distribution, chemical composition, X-ray diffraction pattern, weight loss on heating, pore-free density, and surface area of each powder were measured under steady-state and unsteady-state conditions. The following conclusions were drawn: the steady-state and unsteady-state methods agreed to within about 7%; the unsteady-state method offered no time saving; conductivity of the powder increases with temperature for each material; thermal conductivity increases with increasing volume fraction solid for a given

powder at a fixed temperature, and is critically dependent on volume fraction solid near the maximum volume fraction solid obtainable with a powder; absorbed film, and mechanical pressure on the powder enhanced conductivity; alumina had a slightly lower conductivity than magnesia; and two magnesia powders with the same volume fraction solid and shape factor but different particle size distributions, mean particle sizes, and points of truncation had the same effective thermal conductivity. L.E.W.

N66-32505# Library of Congress, Washington, D. C. Aerospace Technology Div.

CONVECTIVE HEAT AND MASS TRANSFER IN THE COMBUSTION OF CHEMICALLY ACTIVE SUBSTANCES IN THE BOUNDARY LAYER ON A POROUS SURFACE Surveys of Foreign Scientific and Technical Literature

Bartholomew Poplawski 17 Mar. 1966 18 p refs (ATD-66-26)

Methods of thermal protection of various construction materials used under extreme load are discussed, and consideration is given to convective heat and mass transfer in the combustion of chemically active substances in the boundary layer on a porous surface. Special attention is given to one of the methods of thermal protection of surfaces against high-temperature flows, which consists in the feeding of the coolant through a porous surface. The main flow, which flows over the surface, reacts with the coolant. The effect of combustion on the heat and mass transfer process during the injection of gas or liquid was studied in the laminar and turbulent boundary layers. An analysis is made of 15 articles concerned with theoretical investigation of friction and heat transfer in a compressible turbulent boundary layer and with chemical reactions caused by the introduction of a foreign substance. Author

N66-32521# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

THE EFFECT OF LONGITUDINAL VIBRATIONS ON HEAT TRANSFER BY FREE CONVECTION IN AIR, WATER, AND A VISCOUS HYDROCARBON POLYMER

Olin Howard Bradley (M.S. Thesis) Mar. 1966 93 p refs (GAM/ME/66A-1; AD-632395) CFSTI: HC $3.00/MF $0.75

An experimental study was made on the effect of longitudinal vibrations on heat transfer by free convection from a horizontal cylinder in air, water, and a viscous hydrocarbon polymer (Polybutene). Tests were conducted in which the frequency (f) was varied from 0 to 86 cps and the amplitude (x) from 0.005 to 0.16 in. Results of the testing showed no change in the rate of heat transfer for air. The rate of heat transfer in water increased up to 73% when bubbles were attached to the cylinder and increased up to 10% when no bubbles were present. Tests in the viscous Hydrocarbon caused appreciable viscous heating. The rate of heat transfer in the viscous polymer increased to a maximum of 213%. The tests in water and the hydrocarbon polymer showed that the rate of heat transfer began to increase at vibration intensity of FX=0.4 and FX =1.0 respectively (FX is the intensity of vibration cps in.). It is recommended that further tests be made using larger amplitudes and frequencies. Author (TAB)

N66-32534# Utah Univ., Salt Lake City. Dept. of Meteorology.

A NEW BLACK BALL RADIATION CHART AND RADIATIVE EQUILIBRIUM TEMPERATURES COMPUTED THROUGH ITS USE

Roland Emil Barth (M.S. Thesis) Jun. 1966 38 p refs (AD-481947)

Elsasser type radiation tables are presented that take account of the geometry of the 'Black Ball' radiometer. Radiation Equilibrium Temperatures are calculated for three soundings and compared with measured values and calculations made with an equivalent radiation chart based upon Moller's absorption data. Author (TAB)

N66-32547*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

A METHOD FOR COMPUTING CHEMICAL-EQUILIBRIUM COMPOSITIONS OF REACTING-GAS MIXTURES BY REDUCTION TO A SINGLE ITERATION EQUATION

Wayne D. Erickson, Jane T. Kemper, and Dennis O. Allison Washington, NASA, Aug. 1966 30 p refs (NASA-TN-D-3488) CFSTI: HC $1.00/MF $0.50 CSCL 21B

A method for computing the equilibrium chemical composition of a reacting gas mixture is presented wherein all the equilibrium and mass-balance equations are combined algebraically into one equation involving a single unknown. A comparison between this method and a widely used more general method shows that the unit computational speed of the present method can be as much as two orders of magnitude faster. This great advantage in computational speed is achieved at the expense of generality. The present method for computing equilibrium chemical compositions should be useful when applied to systems of intermediate complexity and where a large number of computations are required. Author

N66-32554*# Case Inst. of Tech., Cleveland, Ohio. Engineering Div.

AN EXPERIMENTAL STUDY OF MELTING WAVE BEHAVIOR

Walter H. Edling and Simon Ostrach Jun. 1966 110 p refs (Grant NsG-391) (NASA-CR-76485; FTAS/TR-66-7) CFSTI: HC $3.00/MF $0.75 CSCL 20M

Following a survey of previous melting-wave studies, a flat-plate experiment is described which is designed to investigate the basic nature of waves formed on a melting body in a heated air stream. By varying material properties and ambient conditions, a range of values for a melting parameter, γ, is obtained, and the resulting wave behavior is recorded and analyzed. It is found that the ratio of heating rate to softening rate (indicated by the parameter γ) is very useful in predicting the salient features of melting waves. By relating the data to this parameter and factors derived from the parameter, simple relationships are obtained to define wave velocity, amplitude, and spacing. A "critical" or minimum condition is also established for the appearance of the melt waves. Author

N66-32582# Hughes Aircraft Co., El Segundo, Calif. Space Systems Div.

HIGH-TEMPERATURE, EQUILIBRIUM THERMODYNAMIC PROPERTIES OF CHEMICALLY REACTING MIXTURE OF N_2, O_2, CO_2, A, AND Ne

Philip Adams Jul. 1966 56 p refs Revised *Its* Rept.-9 (SSD-60278R)

Several modified and new computer programs are described for finding the thermodynamic properties of a hot chemically reacting gas mixture subjected to various conditions and processes. The programs are designed for cold gas mixtures composed of arbitrary proportions of N_2, O_2, CO_2, A, and Ne, and as many as 29 species at high temperatures. Among the new programs considered is one which computes the viscosity of a hot gas mixture. A new curve-fitting program is also presented. A modified program is presented of computing, at specified temperature-density temperature-pressure points, the equilibrium composition of a gas mixture consisting of N_2, O_2, CO_2, A, and Ne. The normal shock program is modified to handle cases in which a low velocity is given as input, even though the total velocity is quite high. A program is also described for computing the properties of a gas when the variables of

entropy, density, pressure, and enthalpy are specified. To demonstrate the capabilities of these programs, several sample computations and viscosity calculations are presented. S.P.

34 GENERAL

Includes reports of a broad nature related to industrial applications and technology, and to basic research; defense aspects; law and related legal matters; and legislative hearings and documents.

N66-31646# Office of Aerospace Research, Washington, D.C.
PROCEEDINGS OF THE OAR RESEARCH APPLICATIONS CONFERENCE
[1966] 188 p refs Conf. held in Washington, D.C., 5 Apr. 1966
(AD-631727) CFSTI: HC $5.00/MF $1.00

CONTENTS:

1. A COMPUTATIONAL PROCEDURE FOR OPTIMUM TRAJECTORY AND OPTIMAL CONTROL PROBLEMS R. F. Vachino (AF Acad.) p 1–9 refs (See N66-31647 18-30)

2. BOUNDARY LAYER STUDIES—PRACTICAL IMPLICATIONS E. R. van Driest (N. Am. Aviation) p 11–28 refs (See N66-31648 18-12)

3. SUPERSONIC COMPRESSOR RESEARCH J. W. Steurer (ARL) p 31–43 refs (See N66-31649 18-28)

4. THE ARL INERTIAL PARTICLE SEPARATOR FOR MILITARY TURBINE POWERED VEHICLES R. A. Miller and R. Poplawski (ARL) p 45–69 refs (See N66-31650 18-28)

5. PHOTOELECTRIC PHOTOMETRY—A NEW TOOL FOR SATELLITE SIGNATURES K. E. Kissell (ARL) p 71–99 refs (See N66-31651 18-14)

6. PRECIPITATION IN CERAMICS M. E. Fine (Northwestern Univ.) p 101–118 refs (See N66-31652 18-17)

7. MOLECULAR BEAMS A. T. Stair, Jr. (AFCRL) p 119–129 (See N66-31653 18-24)

8. THE CONTROL OF UNSTABLE MECHANICAL SYSTEMS J. F. Schaefer (AF Acad.) p 131–139 refs (See N66-31654 18-10)

9. THE DETERMINATION OF THE STRUCTURE OF BORON IN "AMORPHOUS" BORON FILAMENTS H. A. Lipsitt (ARL) p 141–150 refs (See N66-31655 18-18)

10. FROM QUANTIZED FLUX TO A FREE PRECESSION NUCLEAR GYRO W. M. Fairbank, W. A. Hamilton, and C. W. F. Everitt (Stanford Univ.) p 153–172 refs (See N66-31656 18-14

N66-31894*# General Electric Co., Santa Barbara, Calif. TEMPO Div.
APPLICATION OF AEROSPACE TECHNOLOGIES TO URBAN COMMUNITY PROBLEMS
M. L. Feldman, L. A. Gonzalez, and A. B. Nadel 23 Sep. 1965 185 p refs
(NASA Order R-5177)
(NASA-CR-76524; RM-65TMP-53) CFSTI: HC $3.25/MF $1.25 CSCL 05K

This study was conducted to clarify the manner in which NASA-developed technology can be used to help existing cities improve their physical, social, and economic environments by resolving some of the more immediate and critical problems in these environments and to aid in planning and developing new urban communities. An evaluative matrix is shown which relates the major ecological categories and subcategories of critical city problems to the major NASA technological categories. The matrix summarizes and classifies the critical city problems identified and discussed in this report and presents the problems in a framework of opportunities for applying technological solutions using NASA-developed technologies. The critical city problems are identified through discussions of the background, nature, and impact of each problem. The study shows that NASA can contribute to the solution of urban community problems through the application and transfer of its technologies. The appendices discuss the application of systems analysis to the municipal police system and waste management, a methodology for hospital and medical facilities planning, and the concept of enclosed communities. R.N.A.

N66-32093# Aerospace Research Labs., Wright-Patterson AFB, Ohio.
AEROSPACE RESEARCH LABORATORIES REPORT ON RESEARCH, 1 JULY 1964–30 JUNE 1965
Jul. 1965 202 p
(ARL-65-160; AD-632786) CFSTI: HC $6.00/MF $1.25

The report is a general accounting devoting a section to each laboratory within Aerospace Research Laboratories. It includes information of all research pursued and accomplished, both in-house and through ARL contracts, during fiscal year 1965. Author (TAB)

N66-32118*# North Carolina Science and Technology Research Center, Raleigh.
REGIONAL TECHNOLOGY TRANSFER PROGRAM Second Quarterly Report, Oct. 1–Dec. 31, 1964
[1964] 27 p refs
(Contract NASr-235)
(NASA-CR-60812) CFSTI: HC $2.00/MF $0.50 CSCL 05B

Details are given on technological data transmission and information processing by computer and other methods in connection with a dissemination program to small and moderate-sized companies. Information is transferred by discussions and conferences with staff consultants, on-site conferences, and by mail and telephone contacts, and referral and procurement advisory services are provided on an intermittent basis. Services provided on a continuing basis include: retrospective computer search of NASA tapes and tape indexes and manual search of all other literature on hand but not cited on the tapes, according to client's field of interest. A listing of computer searches on data retrieved is included; statistics are given on the number of documents disseminated and the categories. R.LI.

N66-32176# Air Force Systems Command, Andrews AFB, Md.
[AIR FORCE LABORATORIES OF THE RESEARCH AND TECHNOLOGY DIVISION REPORT OF FISCAL YEAR 1965]
[1965] 47 p

This report describes progress made during this period in management, technology, and new and continuing research at the Air Force Laboratories' Research and Technology Division. The division's organization, people, laboratory facilities, planning, technical program management, systems engineering and support, procurement, material, and information exchange are discussed. Emphasis is placed on progress in the areas of propulsion, materials, weapons and munitions, flight controls and instrumentation, communications, electronics, laser technology, navigation and guidance, flight vehicles and equipment, new techniques, information displays and processing, and aerospace research. R.N.A.

N66-32287*# California Univ., Los Angeles. Graduate School of Business Administration.

FUNCTIONAL AMBIGUITY AND THE CUSHIONING OF ORGANIZATIONAL STRESS

Fred Masarik [1965] 19p ref Sponsored by NASA

(NASA-CR-76698) CFSTI: HC $1.00/MF $0.50 CSCL 05J

The positive aspects of ambiguity and its function in cushioning organizational stress is discussed. A curvilinear function relating ambiguity to organizational effectiveness shows that optimal effectiveness exists at some intermediate point between maximum ambiguity and maximum clarity. It is pointed out that too little ambiguity limits adjustment to change for individuals and organizational subsystems, and too much ambiguity impedes effectiveness by creating anixiety for individuals and by obscuring guidelines for organizational survival. Several case examples of this ambiguity principle in management operations are presented. A.O.

N66-32482# Atomic Energy Commission, Washington, D. C. Operational Safety Div.

A SUMMARY OF INCIDENTS INVOLVING USAEC SHIPMENTS OF RADIOACTIVE MATERIAL, 1963-1964

Apr. 1966 23 p

(TID-16764, Suppl. 2) GPO: $0.20

Information pertaining to incidents sustained by the AEC in the transportation of radioactive materials during the period from January 1, 1963, through December 31, 1964, is presented. In the period covered, there were twenty-four incidents reported. Thirteen (54%) of the twenty-four incidents did not result in release of radioactive materials. Of the remaining eleven cases, which did involve radiation releases, six were limited to the carrier vehicle and only one involved costly cleanup. Of the twenty-four incidents reported, only one involved impact damage to the shipping container while the vehicles involved suffered damage ranging from none to total destruction. The incidents are classified in accordance with the scheme used in TID-16764. NSA

N66-32588# Congress. Senate. Committee on Aeronautical and Space Sciences.

SPACE TREATY PROPOSALS BY THE UNITED STATES AND U.S.S.R.

Washington, GPO, Jul. 1966 64 p refs Staff Rept. for Comm. on Aeron. and Space Sci., 89th Congr., 2d Sess.

GPO: $0.20

The United States and Soviet draft treaties pertaining to the exploration of the moon and other celestial bodies are presented, and a comparison between the two proposals is drawn. Included as background documents are several United Nations resolutions, the nuclear test ban treaty, and the 1960 Antarctic treaty. The moon exploration records of the United States and the U.S.S.R. are summarized. A bibliography of the publications issued by the Committee on International Space Activities is included, and the member nations of the United Nations Committee on the Peaceful Uses of Outer Space are listed. M.G.J.

N66-32635*# Florida State Univ., Tallahassee. Inst. for Social Research

NASA IMPACT ON BREVARD COUNTY Summary Report

Annie Mary Hartsfield, Mary Alice Griffin, and Charles M. Gregg, ed. 1966 130p refs

(Grant NsG-508)

(NASA-CR-76952) CFSTI: HC $3.00/MF $1.00 CSCL 05C

Studies conducted to assess the political and socio-economic effects of the location of a missile and space flight center in Brevard County are summarized. Community growth patterns are considered in relation to municipal financing, educational systems, and public utilities. Intergovernmental cooperation and attitudes are also surveyed, and the impact of a large influx of newcomers (population) upon the established residents is examined. Community-newcomer relationships and the problems of adaptation are discussed. H.S.W.

Collections of NASA Documents

NASA is depositing its technical documents and bibliographic tools in eleven Federal Regional Technical Report Centers. Each center, located in one of the organizations listed below, is prepared to furnish the general public such services as personal reference, inter-library loans, photocopy service, and assistance in obtaining retention copies of NASA documents.

California: University of California, Berkeley
Colorado: University of Colorado, Boulder
District of Columbia: Library of Congress
Georgia: Georgia Institute of Technology, Atlanta
Illinois: The John Crerar Library, Chicago
Massachusetts: Massachusetts Institute of Technology, Cambridge
Missouri: Linda Hall Library, Kansas City
New York: Columbia University, New York
Pennsylvania: Carnegie Library of Pittsburgh
Texas: Southern Methodist University, Dallas
Washington: University of Washington, Seattle

NASA publications are currently being forwarded to the public libraries in the cities listed below:

Alabama: Birmingham
Alaska: Anchorage
Arizona: Phoenix
Arkansas: Little Rock
California: Los Angeles, Oakland, San Diego, and San Francisco
Colorado: Denver
Connecticut: Hartford and Bridgeport
Delaware: Wilmington
Florida: Miami
Louisiana: New Orleans
Massachusetts: Boston
Michigan: Detroit
Minnesota: St. Paul
Missouri: Kansas City and St. Louis
New Jersey: Trenton
New York: Brooklyn, Buffalo, and Rochester
North Carolina: Charlotte
Ohio: Cleveland, Cincinnati, Dayton, and Toledo
Oklahoma: Oklahoma City
Pennsylvania: Pittsburgh
Tennessee: Memphis
Texas: Fort Worth and San Antonio
Washington: Seattle
Wisconsin: Milwaukee

In addition, NASA regularly sends its publications to the Enoch Pratt Free Library located in Baltimore, Maryland.

An extensive collection of NASA and NASA-sponsored scientific and technical publications available to the public for reference purposes is maintained at the Technical Information Service, American Institute of Aeronautics and Astronautics, 750 Third Avenue, New York, New York 10017.

"The aeronautical and space activities of the United States shall be conducted so as to contribute . . . to the expansion of human knowledge of phenomena in the atmosphere and space. The Administration shall provide for the widest practicable and appropriate dissemination of information concerning its activities and the results thereof."

—NATIONAL AERONAUTICS AND SPACE ACT OF 1958

NASA SCIENTIFIC AND TECHNICAL PUBLICATIONS

TECHNICAL REPORTS: Scientific and technical information considered important, complete, and a lasting contribution to existing knowledge.

TECHNICAL NOTES: Information less broad in scope but nevertheless of importance as a contribution to existing knowledge.

TECHNICAL MEMORANDUMS: Information receiving limited distribution because of preliminary data, security classification, or other reasons.

CONTRACTOR REPORTS: Technical information generated in connection with a NASA contract or grant and released under NASA auspices.

TECHNICAL TRANSLATIONS: Information published in a foreign language considered to merit NASA distribution in English.

SPECIAL PUBLICATIONS: Information derived from or of value to NASA activities. Publications include conference proceedings, monographs, data compilations, handbooks, sourcebooks, and special bibliographies.

TECHNOLOGY UTILIZATION PUBLICATIONS: Information on technology used by NASA that may be of particular interest in commercial and other nonaerospace applications. Publications include Tech Briefs; Technology Utilization Reports and Notes; and Technology Surveys.

Details on the availability of these publications may be obtained from:

SCIENTIFIC AND TECHNICAL INFORMATION DIVISION

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Washington, D.C. 20546